ADS-B GS Test Specifications – Iteration 2

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Abstract

This Verification Plan addresses the ADS-B 1090 Ground Station Test Specifications within the functional ADS-B Ground Surveillance Domain as defined in task T08, ADS-B GS Test Specifications for iteration 2. It includes the following key information:

- Scope and context of the ADS-B Ground Station Tests.
- The Test Specifications applying to the Ground Station for Iteration 2 (derived from D19, D09 and D11).

No particular physical implementation or architecture of the prototypes to be tested is assumed for the Ground Station Tests.
This specification will be revisited as appropriate in the course of the project work on iteration 3.

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Table of Contents

List of tables

List of figures

Executive summary

This Verification Plan presents the Test Specifications to be performed to the ADS-B 1090 MHz Extended Squitter Ground Station (**1090 GS**) covering the different requirements captured and enhanced as described in the 15.4.5a Deliverables: D19 ADS-B Surveillance System Specifications, [2], D09 ADS-B Ground Station Specifications, [3] and D11 Interface Specifications [4].

This document constitutes the second iteration of the test specifications for the 1090 GS, and it is intended to be used by Project 15.4.5.b in order to test the second iteration of the 1090 GS prototype compliant with the ADS-B Surveillance Domain enhancements specified in [2].

The 1090 GS is part of a ground surveillance system that provides airspace and airport surface situational awareness to air traffic controllers and other users. The system provides services that are used by higher-level applications as described in [2]. It makes use of aircraft or vehicles broadcasted ADS-B data, which include position, velocity, status and other information obtained from onboard systems and sensors.

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter (1090 ES) messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports and forward these reports to client systems (typically SDPS) over a Ground Network.

These test specifications are intended to provide the means for verifying the compliance of the equipment to the different requirements not taking into account the physical architecture of the equipment. Hence, allowance is made for different ADS-B Ground Station architectures.

1 Introduction

1.1 Purpose and scope of the document

This document describes the specifications for the second iteration of tests for the ADS-B Ground Surveillance Station.

It is to be used as input documentation for project 15.4.5b producing the test specifications for an ADS-B Ground Station.

The tests shall be described at a high level and shall be refined and tailored in project 15.4.5b.

This document provides the Verification Plan for an ADS-B Ground Station. It describes how requirements defined in D19 ADS-B Surveillance System Specifications [2], D09 ADS-B Ground Station Specifications [3] and D11 Interface Specifications [4] are intended to be verified.

1.2 Intended audience

The audience of this document includes

- Projects 15.04.05.a and b,
- Any other SJU projects that may require ADS-B Surveillance Systems for their verification activities.

1.3 Structure of the document

This section states how the document is organised.

- Chapter 1: Purpose and scope
- Chapter 2: Context of the Verification;
- Chapter 3: Verification Approach;
- Chapter 4: Verification Activities
- Chapter 5: Referenced documents
- Appendices with verification exercises and preliminary coverage matrix.

1.4 Acronyms and Terminology

Term	Definition
1090 ES	1090 MHz Mode S Extended Squitter
1090 GS	ADS-B 1090 MHz Extended Squitter Ground Station
ADD	Aircraft Derived Data
ADS	Automatic Dependent Surveillance
ADS-B	Automatic Dependent Surveillance - Broadcast
ASTERIX	All Purpose Structured EUROCONTROL Surveillance Information Exchange
ATC	Air Traffic Control
ATM	Air Traffic Management
CMS	Control and Monitoring System
Comm-B	Short Downlink Communication Message (Mode S)

DF	Downlink Format
ES	Extended Squitter
EUROCAE	European Organisation for Civil Aviation Equipment
FTC	Format Type Code (ADS-B)
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GS	Ground Station
Hz	Hertz
I/O	Input and/or Output
LSB	Least Significant Bit
MB	Message field in Comm-B (Mode S)
MHz	Megahertz
MOPS	Minimum Operational Performance Standards
MTL	Minimum Trigger Level
N/A	Not applicable
NRA	Non Radar Airspace
PUT/SUT	Product Under Test. This may be used to refer to both System Under Test and Concept Under Test.
RF	Radio Frequency
RTCA	Radio Technical Commission for Aeronautics
SDPD	Surveillance Data Processing and Distribution
SDPS	Surveillance Data Processing System
SESAR	Single European Sky ATM Research Programme
SESAR Programme	The programme which defines the Research and Development activities and Projects for the SJU.
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SJU Work Programme	The programme which addresses all activities of the SESAR Joint Undertaking Agency.
SNMP	Simple Network Management Protocol
SPI	Special Position Identification
SS	Short Squitter
SSR	Secondary Surveillance Radar
TDOA	Time Difference of Arrival
TIS-B	Traffic Information System Broadcast
TOA	Time of Applicability
UTC	Universal Time Coordinated
VP	Validation Plan
WAM	Wide Area Multilateration

2 Context of the Verification

The scope of this Verification Plan is addressed to the ADS-B Ground Station developed in Project 15.4.5b under the requirements defined in D19 ADS-B Surveillance System Specifications[2] D09 ADS-B Ground Station Specifications [3] and D11 Interface Specifications [4].

Main addressed stakeholders are Manufacturers of the ADS-B Ground Station prototypes, ANSPs and ATM Organizations, such as EUROCONTROL.

Project 15.4.5a has developed these test specifications in order to provide Project 15.4.5b with a main input to perform the verification of the prototype of Iteration 2. Project 15.4.5b will take this document as an input and will refine and perform a tailoring of it to suit Project 15.4.5b's needs.

Therefore, the Verification activities will be performed in Project 15.4.5b.

3 Verification Approach

3.1 Verification Overview

Verification activities will take place in Project 15.4.5b, using this document as a ramp-up for a refined verification document to be completed within the Project.

Requirements addressed by D19 ADS-B Surveillance System Specifications [2], D09 ADS-B Ground Station Specifications [3] and D11 Interface Specifications [4] will be verified using different methods (tests, analysis, inspection and design reviews). These will be properly identified in the preliminary Coverage Matrix, which can be found in Appendix K.

Objectives and Tests exercises have been developed according to the SESAR Requirements and V&V Guidelines [5].

They are broken down into the following categories:

- Functional Requirements;
- Performance;
- Interoperability;
- Security.

The layout follows the description in [6].

In accordance with the guidelines in [6] requirement identifiers follow the scheme:

ID-15.04.05.a-TS-00xx.yyyy, where

ID is either **OBJ** for Objective or **EXE** for Test exercise.

xx	Meaning
10	ADS-B RAD Functional req.
12	ADS-B APT Functional req.
13	ADS-B ADD Functional req.
14-19	Reserved for SESAR applications Functional req.
20	ADS-B RAD Performance req.
22	ADS-B APT Performance req.
23	ADS-B ADD Performance req.
24-29	Reserved for SESAR applications Performance req.
30	WAM integration req.

40	Security req.
50	Civil/Military req.
60	1090ES Technology req.
00	Other

Table 1: Identifier Allocation

3.2 Verification Objectives

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0012.0003
Objective	The aim of this objective is to check that the Ground Domain has the capacity to acquire and maintain all Mobiles in the Manoeuvring Area.
Title	Surface squitter decoding
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0012.0003	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0012.0004
Objective	The aim of this objective is to check for all Mobiles on the Manoeuvring Area the Ground Domain is capable of receiving, processing and displaying to the controller the following list of ADS-B surveillance parameters: ☐ Horizontal Position ☐ Identity Information ☐ Pressure Altitude (for airborne aircraft) ☐ Discrete Emergency Code(s) (not required for vehicles) - as a minimum: general emergency, communications failure, unlawful interference.
Title	Surface squitter minimal information
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0012.0004	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0022.0001
Objective	The aim of this objective is to check that the update interval for ADS-B position reports for Mobiles on the airport surface Manoeuvring Area is 1 second at a

	probability of at least 90%
Title	Position Report Update Interval
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0022.0001	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0022.0002
Objective	The aim of this objective is to check that the update interval for ADS-B emergency mode items for aircraft on the airport surface Manoeuvring Area is 2 seconds at a probability of at least 90%.
Title	Emergency Mode Items Update Interval
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0022.0002	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0022.0003
Objective	The aim of this objective is to check that the update interval for non-changing ADS-B items (emitter category, aircraft length/width codes and GNSS antenna offset) for Mobiles on the airport surface Manoeuvring Area is 20 seconds at a probability of at least 90%
Title	Non-changing ADS-B Items Update Interval
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0022.0003	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0022.0004
Objective	The update interval for changing Identity Information on the airport surface Manoeuvring Area is 20 seconds at a probability of at least 90%.
Title	Identity Information Update Interval
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0022.0004	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0022.0005
Objective	The aim of this objective is to check that the probability of the Ground Domain system integrity failure is 1.00E-03 or less per hour
Title	Integrity Failure Probability
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0022.0005	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0022.0006
Objective	The aim of this objective is to check that the probability of the Ground Domain system continuity failure is 1.00E-03 or less per hour.
Title	Continuity Failure Probability
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0022.0006	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0030.0101
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain processes and decodes received WAM data in ASTERIX CAT020. In addition to data specified in Iteration 1, the following minimum data item are decoded: ▪ Measured Height ▪ Mode-S MB Data ▪ Calculated Track Velocity
Title	ADS-B/WAM Shared infrastructure opportunity
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0030.0001	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0030.0102
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain is able to manage the case of WAM reports with duplicated Mode S addresses during the phase of correlation of ADS-B reports with WAM reports.
Title	Duplicate Addresses Management
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0030.0002	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0030.0103
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain is able to check the integrity of the barometric altitude reported in ADS-B reports through the WAM data.
Title	ADS-B/WAM Altitude Data Comparison
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0030.0003	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0030.0104
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain is able to report the WAM Altitude Consistency validation result in the ASTERIX CAT021 ADS-B report.
Title	ADS-B/WAM Altitude Consistency Reporting
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0030.0004	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0030.0107
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain is able to perform a cross check between data in ADS-B report received through 1090 ES and Mode S enhanced data in WAM reports.
Title	ADS-B/WAM Mode S Enhanced Data Comparison
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0030.0007	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0030.0108
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain is able to report the WAM Mode S Enhanced Data validation result in the ASTERIX CAT021 ADS-B report
Title	ADS-B/WAM Mode S Enhanced Data Consistency Reporting
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0030.0008	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0030.0111
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain is able to check the integrity of the velocity reported in ADS-B reports through the WAM data.
Title	ADS-B/WAM Velocity Data Comparison
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0030.00011	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0030.0112
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain is able to report the WAM Velocity validation result in the ASTERIX CAT021 ADS-B report
Title	ADS-B/WAM Velocity Data Consistency Reporting
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0030.00012	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0040.0140
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain is able to calculate for each received ADS-B position message the relative TDOA.
Title	TDOA Calculation
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0040.0040	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0040.0142
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain is able to process the TDOA in order to validate the position information extracted from the position message
Title	TDOA Processing
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0040.0042	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0040.0144
Objective	The aim of this objective is to check the ADS-B Ground Surveillance Domain is able to report the TDOA validation result in the ASTERIX CAT021 ADS-B report
Title	TDOA Techniques reporting
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0040.0044	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0040.0080
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance system validates the track consistency evaluating track behaviour (values and changes of specific a/c attributes to be verified). ***Note:*** *Those specific attributes are: velocity, acceleration, heading, altitude, and vertical rate.*
Title	Track behaviour validation
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0040.0080	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0040.0082
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance system has a set of configurable ranges for each attribute behaviour to be verified based on “ADS-B Emitter Category SET” Code Definitions. ***Note:*** *Those specific attributes are: velocity, vertical rate, altitude, acceleration, and heading.*
Title	Configurable acceptable data value ranges
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0040.0082	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0040.0084
Objective	The aim of this objective is to check that, based on received “ADS-B Emitter Category SET” Code Definitions, the ADS-B Ground Surveillance system verifies the track behaviour against predefined valid configurable attribute ranges for

	each item independently. ***Note:*** *Those specific attributes are: velocity, acceleration, heading, altitude, and vertical rate.*
Title	Verification Process
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0040.0084	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0040.0086
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance system issues the corresponding ATX Cat 021 report with the BAR bits set to adequate values based on the overall result of Track Consistency verification function. ***Note:*** *Track Consistency verification includes:* 1. *velocity versus position change (Iteration 1), and* 2. *track consistency evaluating track behaviour (velocity, vertical rate, altitude, acceleration, and heading) (Iteration 2)*
Title	Verification Process
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0040.0086	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0000.0030
Objective	The ADS-B Ground Surveillance Domain has the capability to monitor the load of the network.
Title	Network load calculation
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0000.0030	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0000.0032
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain has the capability to detect the overload of the network.
Title	Network overload calculation
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0000.0032	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0000.0034
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain has the capability to automatically reduce the load of the network in case of a detected overload, switching to the next level down of degraded data mode.
Title	Automatic switch-over status to degraded mode
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0000.0034	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0000.0036
Objective	The ADS-B Ground Surveillance Domain has the capability to automatically switch back to the next level up of degraded mode or to the normal mode related to the load of the network in the case the detected network load has improved and passed a threshold over a configurable period of time.
Title	Automatic switch-over status to normal mode
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0000.0036	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0000.0038
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain has degraded data mode that could imply: • omission of optional items (several subsets could be configured); • reduced data update rate;

	• geographical filtering
Title	Degraded data mode actions
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0000.0038	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0000.0040
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain has a configurable adaptation strategy (including parameters and switching decisions).
Title	Configurable adaptation strategy
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0000.0040	<Full>

[OBJ Suc]

Identifier	Success Criterion

[OBJ]

Identifier	OBJ-15.04.05.a-TS.0000.0042
Objective	The aim of this objective is to check that the ADS-B Ground Surveillance Domain has means to indicate to external users the currently used mode level (normal, or level of degradation).
Title	Bandwidth mode status signal
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<COVERS>	<ATMS Requirement>	REQ-15.04.05.a-D19-0000.0042	<Full>

[OBJ Suc]

Identifier	Success Criterion

3.3 Verification Assumptions

This verification plan is the second element of a set of three Test Specification Documents.

These tests, will be incremented in the third iteration to include full compliance with new requirements contained in related input documents (ADS-B Surveillance System Specifications, ADS-B Ground Station Specifications and Interface Specifications).

3.4 Verification Requirements on the Concept/System Under Test

Verification requirements on the system under test will be declared for each independent test in its procedure.

3.5 Verification Platform Needs

This document contains a set of type approval tests that can be used to demonstrate compliance with the objectives in section 3.2. These type approval tests are intended to be performed once in order to provide evidence that the ground station design complies with these requirements, and therefore is not intended as a production test or factory acceptance test activity. These test procedures may also be used as a part of a regression test following a design change. It is up to the manufacturer to determine the scope and suitability of regression test activity.

These test procedures were written with the intention of saving manufacturers the time and expense of developing their own tests while providing equipment buyers with a minimum level of assurance that the equipment is compliant with the objectives in section 3.2. Alternative tests may be substituted if it is more convenient to do so as long as any substituted test procedures fully cover all the mandatory requirements of the relevant part of section 3.2.

Since many test procedures require a similar test equipment setup, a standard setup is defined here and specific test procedures reference this section, specifying exceptions when necessary.

The test procedures are listed in this Section. Except where otherwise noted, the sub-section number of each test procedure matches the corresponding sub-section number within Section 3.2 containing the requirements being tested.

Test Equipment Setup

A diagram of the verification platform with standard test equipment setup is shown in Figure 1.

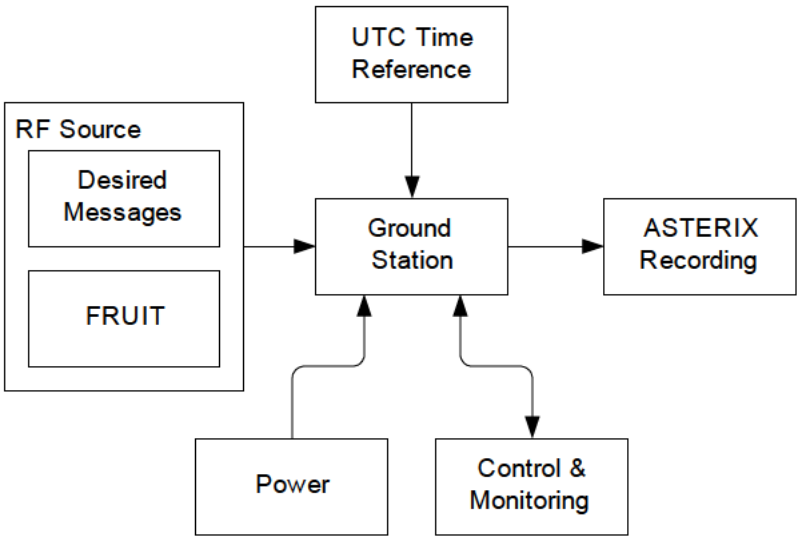

Figure 1: Standard Test Equipment Setup (Logical Connections)

Note: Figure 1 and the remainder of this section describe the test equipment in terms of functions. The functions may be implemented with one or more items of equipment as long as the required capabilities are provided.

The following picture is taken from the ED-163 document and shows the functional architecture for the ADS-B APT application.

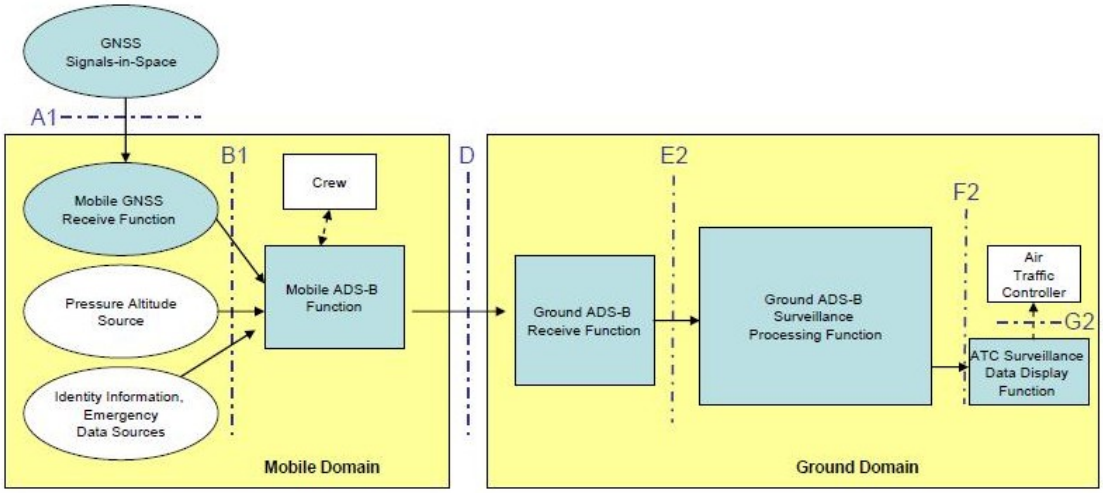

Figure 2: ADS-B APT Functional Architecture

Deliverables D19 ADS-B Surveillance System Specifications[2] maps APT requirements on the ADS-B Ground Surveillance Domain as defined in Figure 2 according to the following Table:

Table 1: Mapping of ED-163 Functions to Project 15.4.5a functions

ED-163/DO-321 Functional Component	P15.4.5a Functional Component
Ground ADS-B Receive Function	ADS-B Ground Station
Ground ADS-B Surveillance Processing Function	SDPD
ATC Surveillance Data Display Function	Interfaces

3.5.1 RF Source of Desired Messages

Desired messages shall meet the requirements of sections 2.2.2.1 and 2.2.3.1 of DO-260A and DO-260B. The source shall be capable of producing messages with an adjustable power level from MTL to -10 dBm at the Ground Station input. The source shall be capable of producing messages simulating 300 targets simultaneously. Desired messages shall not overlap each other. The source shall be capable of producing messages for each simulated target at the rates shown in Table 2.

Table 2: Message Rates for Desired Messages

Message Type	Message Rate (per second)	Notes
Airborne Position	2	one even, one odd FTC = 9-18, 20-22
Airborne Velocity	2	FTC = 19, Subtype = 1-4
Aircraft Identification	0.2	FTC = 1-4
Target State and Status	0.8	FTC = 29, Subtype = 0
Aircraft Operational Status	0.4	FTC = 31, Subtype = 0
Aircraft Status	0.4	FTC = 28, Subtype = 1
Surface Position	2	FTC = 5-8

Dithered transmission intervals, as specified in DO-260A and DO-260B section 2.2.3.3.1, are permissible but not required. Simulated targets may be moving or stationary. Stationary targets must have velocity messages.

3.5.2 RF Source of FRUIT

The FRUIT source shall be capable of producing Mode A/C, Mode S short and Mode S long messages randomly distributed in time with the power distribution shown in Table 3 according to [12].

Table 3: Amplitude and Message Type Distribution of the Injected FRUIT

Signal Level dBm	A/C Squitters	Short Squitters	Extended Squitters	Cumulative A/C	Cumulative SS	Cumulative ES	Cumulative SS+ES
-74	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-75	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-76	11.4	27.6	6.2	11.4	27.6	6.2	33.8
-77	0.0	0.0	0.0	11.4	27.6	6.2	33.8
-78	5.7	24.8	9.3	17.1	52.4	15.5	67.9
-79	4.0	20.4	15.5	21.1	72.7	31.0	103.7
-80	3.5	12.0	6.2	24.5	84.7	37.2	121.9
-81	27.6	85.4	24.8	52.2	170.1	62.0	232.1
-82	19.7	91.3	24.8	71.8	261.4	86.8	348.2
-83	12.3	47.8	21.7	84.2	309.2	108.5	417.7
-84	30.7	95.6	34.1	114.9	404.8	142.6	547.4
-85	45.7	118.3	46.5	160.6	523.1	189.1	712.2
-86	60.4	189.5	55.8	221.0	712.6	244.9	957.5
-87	119.5	299.5	93.0	340.4	1012.1	337.9	1350.0
-88	85.8	218.1	62.0	426.2	1230.1	399.9	1630.0
-89	108.9	271.3	80.6	535.1	1501.5	480.5	1982.0
-90	163.7	405.9	105.4	698.8	1907.4	585.9	2493.3
-91	177.2	443.2	114.7	876.0	2350.6	700.6	3051.2
-92	169.8	502.6	124.0	1045.8	2853.2	824.6	3677.8
-93	100.4	277.9	65.1	1146.2	3131.1	889.7	4020.8
-94	113.7	259.4	55.8	1259.9	3390.5	945.5	4336.0
-95	134.2	313.6	49.6	1394.1	3704.1	995.1	4699.2
-96	48.7	164.2	27.9	1442.8	3868.3	1023.0	4891.3
-97	42.3	84.2	12.4	1485.1	3952.5	1035.4	4987.9
-98	1.2	5.7	3.1	1486.3	3958.1	1038.5	4996.6
-99	2.8	13.2	3.1	1489.1	3971.3	1041.6	5012.9
-100	0.0	0.0	0.0	1489.1	3971.3	1041.6	5012.9
-101	0.0	0.0	0.0	1489.1	3971.3	1041.6	5012.9

The quoted amplitudes assume a zero gain reference antenna. These amplitudes must be adjusted to match the typical gain of the antenna or a FRUIT injection directly to the sensor's RF input the 1090 ES Ground Station is to be used with.

Note: The data content of the Mode S FRUIT transmissions is not critical, since one and zero bits have equal energy content. The Mode A/C replies should have half the code bits set (e.g. 0707 or 2525) to reflect the average energy content of all messages. It may be

useful to use non-ADS-B DF codes (e.g. 20) for the Mode S ES messages to prevent valid FRUIT ADS-B messages from appearing in the ASTERIX data.

3.5.3 UTC Time Reference

A means of disabling or disconnecting the UTC time reference shall be provided.

3.5.4 Control and Monitoring Equipment

Control and monitoring equipment shall be present as to interface with the 1090 ES Ground Station. A means of polling the Ground Station for values of all parameters shall be provided. The control and monitoring equipment shall allow a user to authenticate with and control the Ground Station.

3.5.5 ASTERIX Recording Equipment

The ASTERIX recording equipment shall timestamp and record all ASTERIX reports sent from the 1090 ES Ground Station.

The control and monitoring equipment, ASTERIX recording equipment and any other network capable test equipment may be connected through suitable networking equipment.

All test equipment requiring calibration shall have documentation showing that the equipment calibration is valid.

3.5.6 Default Configuration, Mode and State

a) The 1090 ES Ground Station and all of the test equipment shall be powered on before the beginning of each test.

b) The 1090 ES Ground Station shall be configured to the default parameter values

c) The mode shall be Operational.

d) The state shall be Online.

e) The time state shall be UTC coupled.

f) The 1090 ES Ground Station shall have no information on any targets.

g) Network configuration parameters shall be assigned so that the 1090 ES Ground Station can communicate with the control and management equipment, the ASTERIX recording equipment and any other network connected test equipment.

h) The maximum bit rate of the GS shall be set to the maximum value appropriate for the network.

i) The 1090 ES Ground Station shall have a suitable configured own position (GS Latitude, GS Longitude) or self-determined (e.g. GPS self-survey) Ground Station location.

j) The default power level for injected test messages shall be MTL + 3dB.

k) FRUIT generation shall not be enabled by default.

3.5.7 Message Set Construction

Message sequences for individual targets must be constructed carefully to produce ASTERIX Category 021 output.

3.5.8 Initial Position Messages

Sequences must begin with two even-odd (or odd-even) pairs of messages to allow the Ground Station to acquire the target.

The position messages in each of the first two pairs of messages must be less than 10 seconds apart.

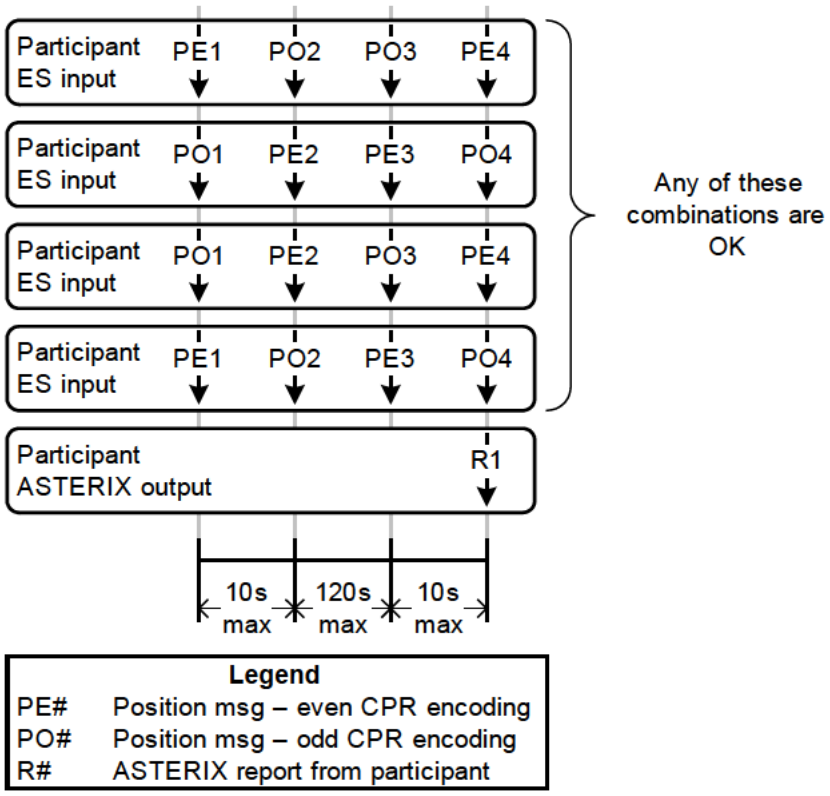

Figure 3: Initial Position Messages

The position conveyed in the first pair of messages must be within the Max Range of the configured (GS Latitude, GS Longitude) or self-determined (e.g. GPS self-survey) Ground Station location.

If moving targets are used, the position change from one message to the next in each of the first two pairs of messages (i.e. from 1 to 2 and from 3 to 4) must be less than 3 NM in both latitude and longitude.

If the scenario is correct, the first ASTERIX report will be produced after the 2nd pair of even-odd messages.

Scenario design may be easier to verify in data-driven reporting mode.

3.5.9 Field Values

Most tests will use data from just a few 1090 ES message fields. If the number of values that can be conveyed by a field is small, then all the values should be tested. A one-bit field has only two possible values, so both should be tested. If the number of values that can be conveyed by a field is large, a subset of the values should be checked. For example, there are thousands of possible altitude values that can be conveyed in position messages. An appropriate subset of these values would include minimum, minimum + 1 LSB, maximum, maximum – 1 LSB and a value in the middle of the altitude range.

Fields that are not relevant for a specific test should be assigned random values (respecting the field proper range). The values may be static throughout a scenario or they may change. Random values in seemingly irrelevant fields will confirm that the outputs are dependent only on the expected fields. The random values must be chosen so they do not stop the output of the Ground Station. For example, if the Flight Level data item is being verified, randomised position values must not change by more than 6 NM between successive reports less than 30 seconds apart.

3.5.10Altitude Values

Airborne position messages should contain barometric altitude unless geometric altitude is required for a specific test.

3.5.11Configuration Changes

When a specific test procedure calls for changing a 1090 ES Ground Station configuration parameter value, assume that the user will authenticate with the Ground Station, put the Ground Station in maintenance mode, change the parameter(s), put the Ground Station back into operational mode and then log out of the Ground Station. If the Ground Station was in maintenance mode or the user was already authenticated, then the mode change and authentication steps are not necessary.

3.5.12 Checking of Log Files

Ground Station logs shall be checked at the conclusion of each test for unexpected warnings, errors or other anomalies. Any unexpected error or anomaly constitutes a test failure.

3.6 Integration and preliminary Verification activities

This section cannot be defined at this stage of the Project (Iteration 2): Project 15.4.5a will refine in forthcoming version (Iteration 3) of this document.

In any case, preliminary Verification activities will be limited at this stage at visual inspections of the elements that are part of the System Under Test to guarantee that it is ready to undergo the Verification activity.

Manufacturers of the Systems can define additional criteria for both the integration and preliminary activities, being the main stakeholders for the Verification activities.

3.7 Acceptance criteria

This section cannot be defined at this stage of the Project (Iteration 2): Project 15.4.5a has got 1 additional Iteration which will be used to refine this document up to a concise final.

4 Verification Activities

4.1 Verification Exercises List

[EXE]

Identifier	EXE-15.04.05.a-TS.0012.0003
Exercise	ADS-B surveillance parameters in Manoeuvring area
Title	ADS-B surveillance parameters in Manoeuvring area
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0012.0003	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0012.0004	<Full>

[EXE]

Identifier	EXE-15.04.05.a-TS.0022.0001
Exercise	GS Report Probability for Target on the airport surface Manoeuvring Area
Title	GS Report Probability for Target on the airport surface Manoeuvring Area
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
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[EXE]

Identifier	EXE-15.04.05.a-TS.0022.0002
Exercise	GS Update probability on airport manoeuvring area for emergency mode items
Title	GS Update probability on airport manoeuvring area for emergency mode items
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>

Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

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[EXE]

Identifier	EXE-15.04.05.a-TS.0022.0003
Exercise	GS Update interval for non-changing ADS-B items
Title	GS Update interval for non-changing ADS-B items
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
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[EXE]

Identifier	EXE-15.04.05.a-TS.0022.0004
Exercise	GS Changing Identity Information on the airport surface Manoeuvring Area
Title	GS Changing Identity Information on the airport surface Manoeuvring Area
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0022.0004	<Full>

[EXE]

Identifier	EXE-15.04.05.a-TS.0022.0005
Exercise	GS Integrity and continuity failure in APT environment
Title	GS Integrity and continuity failure in APT environment
Status	<In Progress>
Responsible Project	N/A

Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
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<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS-0022.0006	<Full>

[EXE]

Identifier	EXE-15.04.05.a-TS.0030.0001
Exercise	GS WAM Integrity Check
Title	GS WAM Integrity Check
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
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[EXE]

Identifier	EXE-15.04.05.a-TS.0040.0040
Exercise	GS Time Differential of Arrival Validation
Title	GS Time Differential of Arrival Validation
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
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<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0040.0044	<Full>

[EXE]

Identifier	EXE-15.04.05.a-TS.0040.0080
Exercise	GS Track Behaviour Analysis
Title	GS Track Behaviour Analysis
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
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<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0040.0084	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0040.0086	<Full>

[EXE]

Identifier	EXE-15.04.05.a-TS.0000.0030
Exercise	GS Automatic Bandwidth optimization techniques
Title	GS Automatic Bandwidth optimization techniques
Status	<In Progress>
Responsible Project	N/A
Exercise Plan	N/A
Planned Execution Date	N/A
Planned Analysis Date	N/A
Activity Type	<Test>
Exercise Level	<Function>
Lifecycle Phase	<V2>
V&V Technique	<Real Time Simulation>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
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<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0000.0034	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0000.0036	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0000.0038	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0000.0040	<Full>
<EMBEDS>	<V&V Objective>	OBJ-15.04.05.a-TS.0000.0042	<Full>

4.2 Verification Exercises Planning

N/A.

5 References

[1] SJU 15.04.05a Specification Baseline Document, D17, Ed. 00.01.00, Oct 2010

[2] SJU 15.04.05a, ADS-B Ground Surveillance Specifications for Second Iteration *D19*

[3] SJU 15.04.05a, *ADS-B Ground Station Specifications for Second Iteration, D09*

[4] SJU 15.04.05a, *Interface Specifications for Second Iteration, D11*

[5] SESAR Requirements and V&V Guidelines version 02.00.00

[6] SESAR Toolbox User Manual version 02.00.00

[7] EUROCAE/RTCA MOPS for 1090 MHz ADS-B, ED-102/DO-260, Sept. 2000

[8] RTCA MOPS for 1090ES ADS-B and TIS-B, DO-260A, Dec. 2006 (includes Changes 1 and 2)

[9] EUROCAE/RTCA MOPS for 1090ES ADS-B and TIS-B, ED-102A/DO-260B, Dec. 2009

[10]EUROCAE/RTCA SPIR Document for ADS-B NRA Application, ED-126/DO-303, Dec. 2006

[11]EUROCAE/RTCA SPIR Document for ADS-B RAD Application, ED-161/DO-318, Sept. 2009

[12]EUROCAE ED129: Technical Specification for a 1090 MHz Extended Squitter ADS-B Ground Station, June 2010

[13] EUROCONTROL ASTERIX Standards CAT 21, Ed 2.0j, Oct 2011,

[14] EUROCONTROL ASTERIX Standards CAT 23, Ed 2.0c, Oct 2011

[15] EUROCONTROL ASTERIX Standards CAT 62, ED 2.0e, Oct 2011

[16] EUROCONTROL ASTERIX Standards CAT 63, Ed 1.3, July 2007

[17] EUROCONTROL ARTAS V8, System/Segment Specifications, Doc. 46 127 300 – 305

Appendix A
Verification Exercise EXE-15.04.05.a-TS.0012.0003 - ADS-B surveillance parameters in Manoeuvring area

A.1Exercise Scope and Justification

A.1.1 Exercise Level

The level of the exercise is functional.

A.1.2 Exercise Type

The type of this exercise is Test.

A.1.3Description of the system being addressed

ADS–B Ground Station.

A.1.4 Context of the verification exercise

This document is applied to FAT (Factory Acceptance Test).

A.1.5 Required Datasets

1090 MHz Extended Squitter Messages input and 1090 GS ASTERIX output, containing all kind of surface messages (FTC 5-8).

A.1.6 Verification objectives

Verify that the 1090 ES Ground Station is capable of receiving, processing and displaying to the controller the ADS-B surveillance information for all mobiles on the Manoeuvring Area.

OBJ-15.04.05.a-TS.0012.0003
The aim of this objective is to check that the Ground Domain has the capacity to acquire and maintain all Mobiles in the Manoeuvring Area.

OBJ-15.04.05.a-TS.0012.0004
The aim of this objective is to check for all Mobiles on the Manoeuvring Area the Ground Domain is capable of receiving, processing and displaying to the controller the following list of ADS-B surveillance parameters: ☐ Horizontal Position ☐ Identity Information ☐ Pressure Altitude (for airborne aircraft) ☐ Discrete Emergency Code(s) (not required for vehicles) - as a minimum: general emergency, communications failure, unlawful interference.

A.1.7 Inputs

A known number of surface targets in order to simulate a load in accordance to the scenario for a manoeuvring area.

A.1.8 Outputs

ASTERIX Report Recording.

A.1.9Entrance criteria

Start the generation of ADS–B messages.

A.1.10 Exit Criteria

The Test will finish after the generation of all messages foreseen in the input.

A.1.11 Exercise procedure

Exercise ID/Title: EXE-15.04.05.a-TS.0012.0003 / ADS-B surveillance parameters in Manoeuvring area

Pass Criteria:	The test is passed if it is possible to verify that the 1090 ES Ground Station is capable of receiving, processing and displaying to the controller the ADS-B surveillance minimum information for all mobiles on the Manoeuvring Area sending ADS-B messages FTC 5 – 8.
Exercise Type:	Test
Precondition(s):	The test equipment setup will be in line with the one described in Section A.1.13 (see below). The test messages shall be configured in order to simulate 4 targets, all within the coverage range of the 1090 ES Ground Station Each of the targets will send ADS-B surface messages with a different kind of FTC (Target 1 FTC=5, Target 2 FTC= 6, Target 3 FTC=7, Target 4 FTC =8). At certain point in time during the scenario, the next conditions shall take place: Target 1 will change from “no emergency” to “general emergency” in target State and status message. After two minutes, Target 1 will change from “no emergency” to “general emergency” in target State and status message. Target 2 will change from “no emergency” to “no communications” in target State and status message. After two minutes, Target 2 will change from “no communications” to “general emergency” in target State and status message. Target 3 will change from “no emergency” to “unlawful interference” in target State and status message. After two minutes, Target 3 will change from “unlawful interference” to “general emergency” in target State and status message.
Note(s):	The recorded data may contain all kind of surface messages. The number of ADS-B messages must be known.
Device(s) in use:	- Ground Station ADS-B - Input Source for Fruit and ADS-B Messages. - ASTERIX Recording Tool - Power - UTC time Reference

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the 1090 GS in the default configuration.			
2	In the 1090 GS select data driven reporting mode			
3	Configure the recording tool to capture ASTERIX reports coming from the ADS-B GS.			
4	Prepare the message source to play the scenario			
5	Inject the Target message into the 1090 ES Ground Station			
6	Allow the recording to run for sufficient time to record all the messages.			
7	Stop the recording.			
8	By comparison of the recorded data against the known mobiles information, verify that minimum Items to be processed are present and in line with the values generated in input.			
9	Verify that the number of reported mobiles is the same that the number of mobiles generated at input.			

Exercise result:

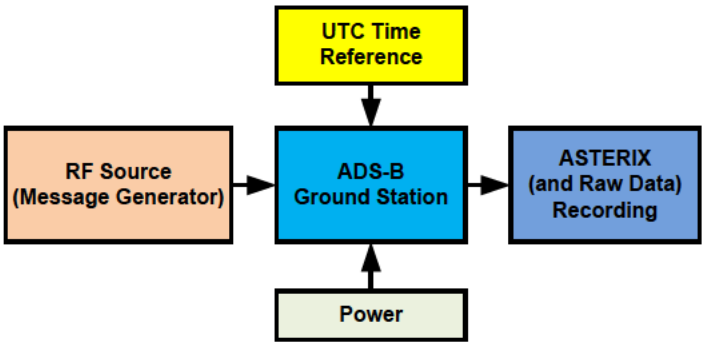
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 4: Verification Exercise Result

A.1.12 Verification SUT requirements

N/A

A.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

-Ground Station ADS–B

-RF Source for ADS –B Message

-ASTERIX Recording Tool

-Power

-UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports.

RF Source of Desired Messages

The RF Source of Desired Messages will be capable to generate the Desired 1090 MHz messages in accordance with the Standard DO 260 – DO 260A – DO 260B.

UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

A.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

A.1.15 Platform Configuration

N/A

A.1.16 Configuration(s) Identification of the Verification Platform

N/A

A.1.17 Links to other Verification Exercises

N/A

A.1.18 Representatively level/ limitations

N/A

A.2 Exercises Planning and management

A.2.1 Activities

A.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and A.1.13 in order to meet the Test Preconditions

A.2.1.2Execution activities

Play the scenario generating in the input the Desired 1090 MHz messages and record the relevant ASTERIX output.

A.2.1.3 Post execution activities

Verify that the information reported in the recorded ASTERIX Report is consistent with the input messages and the number of mobiles generated at input is the same that the number of the mobiles reported.

A.2.2 Human Resources

N/A

A.2.3 Responsibilities in the exercise

N/A

A.2.4 Training

N/A

A.2.5 Time planning

N/A

A.2.6 Risks

N/A

A.2.7 Errors and Observation handling

N/A

A.3 Analysis Specification

A.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after the test execution, the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in input.

A.3.2 Analysis method

N/A

A.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 and ASTERIX CAT 23 item.

Appendix B
Verification Exercise EXE-15.04.05.a-TS.0022.0001 - GS Report Probability for Target on the airport surface Manoeuvring Area

B.1Exercise Scope and Justification

B.1.1 Exercise Level

The level of the exercise is functional.

B.1.2 Exercise Type

The type of the exercise is Test.

B.1.3 Description of the system being addressed;

ADS–B Ground Station.

B.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

B.1.5 Required Datasets

1090 MHz Extended Squitter Messages input and 1090 GS ASTERIX output, containing at least 500,000 ADS–B messages from targets under study

B.1.6 Verification objectives

Verify the Requirements related to the ADS-B APT Performance Requirements, more specifically, the following requirement:

OBJ-15.04.05.a-TS.0022.0001
The aim of this objective is to check that the update interval for ADS-B position reports for Mobiles on the airport surface Manoeuvring Area is 1 second at a probability of at least 90%

B.1.7Inputs

A number of targets in order to simulate the maximum Ground Station's load in accordance to Airport Scenario. At least 500,000 ADS–B messages should be analized.

B.1.8Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system 'Raw data output' reports.

B.1.9 Entrance criteria

Start the generation of input data.

B.1.10 Exit Criteria

Finished recording and performed analysis.

B.1.11 Exercise procedure

Exercise ID/Title: EXE-15.04.05.a-TS.0022.0001 **/** GS Report Probability for Target on the airport surface Manoeuvring Area

Pass Criteria: This test is passed if it is possible to verify that the update interval for ADS-B position reports for Mobiles emergency mode items for aircraft on the airport surface Manoeuvring Area is 12 seconds at a probability of at least 90%.

Exercise Type: Test

Precondition(s):
- Test equipment is setup as described above
- GS under test is active, and ready for test.

Note(s): N/A

Device(s) in use: SUT is ADS-B GS.

This test procedure verifies that the 1090 ES Ground Station is able to provide ATX021 target report updates for any moving Mobile on the airport surface within 1 sec from the last report with probability of at least 90%.

In order to test the ability to produce a target report, test steps to be done are without FRUIT, with Mode A/C FRUIT overlapping, and with Mode S FRUIT overlapping.

Step 1:

This test procedure verifies that the 1090 ES Ground Station is able to to provide ATX021 target report updates for any moving Mobile on the airport surface within 1 sec from the last report with probability of at least 90%.

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class:

–84 dBm for A3 equipment class.

The scenario consists of an aircraft transmitting surface position messages with a rate of 2 Hz for a time period of 100 seconds. ASTERIX output shall be recorded. Compare the output with the known content of the injected input. Compare the output with the known content of the injected input. Calculate the measured probability that time difference between two following squitter receptions is not greater than 1 second in 90% cases.

Step 2:

This test procedure verifies that the 1090 ES Ground Station is able to provide, in environment with Mode A/C FRUIT, ATX021 target report updates for any moving Mobile on the airport surface within 1 sec from the last report with probability of at least 90%.

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class:

–84 dBm for A3 equipment class.

Set the power level of three Mode A/C FRUIT sources at the receiver input to the value corresponding to the UUT equipment class:

-76, -72 and –68 dBm for A3 equipment class.

Activate the Mode A/C FRUIT source so that the FRUIT is pseudo randomly distributed across the Extended Squitter preamble and data block as specified in §2.4.4.4.2.1 of DO-260B.

The scenario consists of an aircraft transmitting surface position messages with a rate of 2 Hz for a time period of 100 seconds.

Compare the output with the known content of the injected input. Calculate the measured probability that time difference between two following squitter receptions is not greater than 1 second in 90% cases.

Step 3:

This test procedure verifies that the 1090 ES Ground Station is able to provide, in environment with Mode S FRUIT, ATX021 target report updates for any moving Mobile on the airport surface within 1 sec from the last report with probability of at least 90%.

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class plus 12 dB:

–72 dBm for A3 equipment class.

Set the power level of Mode S FRUIT sources at the receiver input to the value corresponding to the UUT equipment class:

-80 dBm for A3 equipment class.

Activate the Mode S FRUIT source so that the Mode S FRUIT is pseudo randomly distributed across the data Extended Squitter data block as specified in §2.4.4.4.2.1.2 of DO-260B.

The scenario consists of an aircraft transmitting surface position messages with a rate of 2 Hz for a time period of 100 seconds.

Compare the output with the known content of the injected input. Calculate the measured probability that time difference between two following squitter receptions is not greater than 1 second in 90% cases.

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			

5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

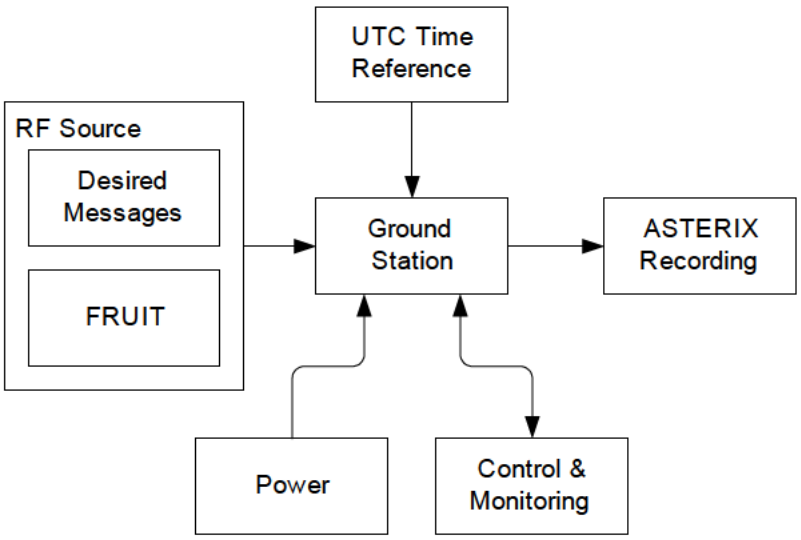
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 5: Verification Exercise Result

B.1.12 Verification SUT requirements

N/A

B.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

-Ground Station ADS–B

-Message Generator

-ASTERIX (and Raw Data) Recording Tool

-Power Source

-UTC time Reference.

The Item reported above will be capable to perform the functionalities reported below.

Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

RF Source of Desired Messages

The RF Source of Desired Messages will be capable to generate the Desired1090 MHz messages in accordance with the Standard DO 260 – DO 260A – DO 260B.

RF Source of FRUIT

The RF Source of FRUIT will be capable of producing Mode A/C, Mode S short and Mode S long messages randomly distributed in time.

UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

B.1.14 Verification Platform needs

See 3.5 Verification Platform Needs.

B.1.15 Platform Configuration

N/A

B.1.16 Configuration(s) Identification of the Verification Platform

N/A

B.1.17 Links to other Verification Exercises

N/A

B.1.18 Representatively level/ limitations

N/A

B.2 Exercises Planning and management

B.2.1 Activities

B.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and B.1.13 in order to meet the Test Preconditions.

B.2.1.2 Execution activities

Play the scenario generating in input the desired messages and record the relevant ASTERIX (and Raw Data) output.

B.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

B.2.2 Human Resources.

N/A

B.2.3 Responsibilities in the exercise

N/A

B.2.4 Training

N/A

B.2.5 Time planning

N/A

B.2.6 Risks.

N/A

B.2.7 Errors and Observation handling

N/A

B.3 Analysis Specification

B.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

B.3.2 Analysis method

N/A

B.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

Appendix C
Verification Exercise EXE-15.04.05.a-TS.0022.0002 - GS Update probability on airport manoeuvring area for emergency mode items

C.1Exercise Scope and Justification

C.1.1 Exercise Level

The level of the exercise is functional.

C.1.2 Exercise Type

The type of the exercise is Test.

C.1.3 Description of the system being addressed;

ADS–B Ground Station.

C.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

C.1.5 Required Datasets

1090 MHz Extended Squitter Messages input and 1090 GS ASTERIX output, containing at least 500,000 ADS–B messages from targets under study.

C.1.6 Verification objectives

Verify the Requirements related to the ADS-B APT Performance Requirements, more specifically, the following requirement:

OBJ-15.04.05.a-TS.0022.0002
The aim of this objective is to check that the update interval for ADS-B emergency mode items for aircraft on the airport surface Manoeuvring Area is 2 seconds at a probability of at least 90%.

C.1.7Inputs

A number of targets in order to simulate the maximum Ground Station's load in accordance to Airport Scenario. At least 500,000 ADS–B messages should be analized.

C.1.8Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system 'Raw data output' reports.

C.1.9 Entrance criteria

Start the generation of input data.

C.1.10 Exit Criteria

Finished recording and performed analysis.

C.1.11 Exercise procedure

Exercise ID/Title: EXE-15.04.05.a-TS.0022.0002**/** GS Update probability on airport manoeuvring area for emergency mode items

Pass Criteria: The test is passed if it is possible to verify that the update interval for ADS-B emergency mode items for aircraft on the airport surface Manoeuvring Area is 2 seconds at a probability of at least 90%.

Exercise Type: Test

Precondition(s):
- Test equipment is setup as described above
- GS under test is active, and ready for test.

Note(s): N/A

Device(s) in use: SUT is ADS-B GS.

This test procedure verifies that the 1090 ES Ground Station is able to provide on ATX021 target report an emergency mode update from a Mobile on the airport surface Manoeuvring Area within 2 seconds with a probability of at least 90%

In order to test the ability to produce a target report, test steps to be done are without FRUIT, with Mode A/C FRUIT overlapping, and with Mode S FRUIT overlapping.

Step 1:

This test procedure verifies that the 1090 ES Ground Station is able to provide on ATX021 target report an emergency mode update from a Mobile on the airport surface Manoeuvring Area within 2 seconds with a probability of at least 90%

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class:

–84 dBm for A3 equipment class.

The scenario shall consist of an aircraft transmitting (after the occurrence of an emergency event) surface position messages with a rate of 2 Hz and Aircraft Status (TYPE=28) Emergency/Priority Status ADS-B Message (SUBTYPE=1) for a time period of 100 seconds.

Compare the output with the known content of the injected input. Compare the output with the known content of the injected input. Calculate the measured probability that time difference between two following receptions of Emergency Mode items is not greater than 2 second in 90% cases.

Step 2:

This test procedure verifies that the 1090 ES Ground Station is able to provide, in environment with Mode A/C FRUIT, ATX021 target report updates for any moving Mobile on the airport surface within 1 sec from the last report with probability of at least 90%.

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class:

–84 dBm for A3 equipment class.

Set the power level of three Mode A/C FRUIT sources at the receiver input to the value corresponding to the UUT equipment class:

-76, -72 and –68 dBm for A3 equipment class.

Activate the Mode A/C FRUIT source so that the FRUIT is pseudo randomly distributed across the Extended Squitter preamble and data block as specified in §2.4.4.4.2.1 of DO-260B.

The scenario shall consist of an aircraft transmitting (after the occurrence of an emergency event) surface position messages with a rate of 2 Hz and Aircraft Status (TYPE=28) Emergency/Priority Status ADS-B Message (SUBTYPE=1) for a time period of 100 seconds.

Compare the output with the known content of the injected input. Compare the output with the known content of the injected input. Calculate the measured probability that time difference between two following receptions of Emergency Mode items is not greater than 2 second in 90% cases.

Step 3:

This test procedure verifies that the 1090 ES Ground Station is able to provide, in environment with Mode S FRUIT, ATX021 target report updates for any moving Mobile on the airport surface within 1 sec from the last report with probability of at least 90%.

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class plus 12 dB:

–72 dBm for A3 equipment class.

Set the power level of Mode S FRUIT sources at the receiver input to the value corresponding to the UUT equipment class:

-80 dBm for A3 equipment class.

Activate the Mode S FRUIT source so that the Mode S FRUIT is pseudo randomly distributed across the data Extended Squitter data block as specified in §2.4.4.4.2.1.2 of DO-260B.

The scenario shall consist of an aircraft transmitting (after the occurrence of an emergency event) surface position messages with a rate of 2 Hz and Aircraft Status (TYPE=28) Emergency/Priority Status ADS-B Message (SUBTYPE=1) for a time period of 100 seconds.

Compare the output with the known content of the injected input. Compare the output with the known content of the injected input. Calculate the measured probability that time difference between two following receptions of Emergency Mode items is not greater than 2 second in 90% cases.

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system			

	ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

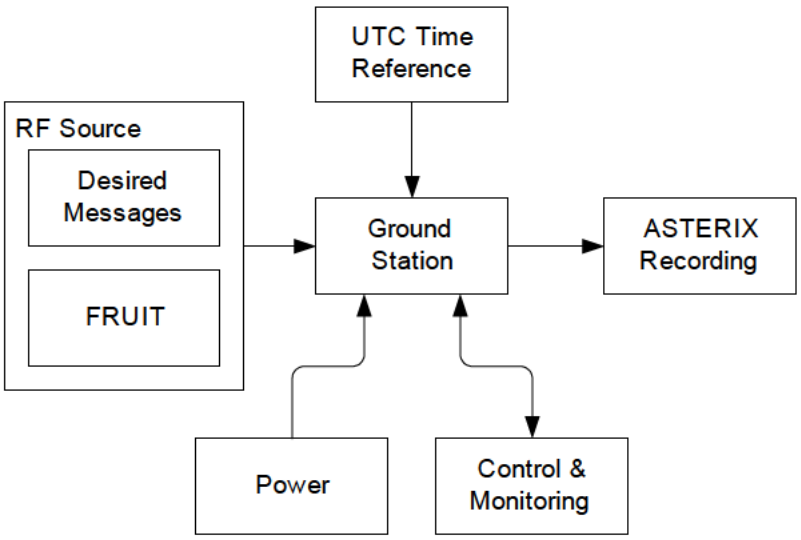
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 6: Verification Exercise Result

C.1.12 Verification SUT requirements

N/A

C.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

-Ground Station ADS–B

-Message Generator

-ASTERIX (and Raw Data) Recording Tool

-Power Source

-UTC time Reference.

The Item reported above will be capable to perform the functionalities reported below.

Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

RF Source of Desired Messages

The RF Source of Desired Messages will be capable to generate the Desired1090 MHz messages in accordance with the Standard DO 260 – DO 260A – DO 260B.

RF Source of FRUIT

The RF Source of FRUIT will be capable of producing Mode A/C, Mode S short and Mode S long messages randomly distributed in time.

UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

C.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

C.1.15 Platform Configuration

N/A

C.1.16 Configuration(s) Identification of the Verification Platform

N/A

C.1.17 Links to other Verification Exercises

N/A

C.1.18 Representatively level/ limitations

N/A

C.2 Exercises Planning and management

C.2.1 Activities

C.2.1.1 Preparatory activities

Setup the tools/equipment listed in C.1.13 in order to meet the Test Preconditions.

C.2.1.2 Execution activities

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

C.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

C.2.2 Human Resources.

N/A

C.2.3 Responsibilities in the exercise

N/A

C.2.4 Training

N/A

C.2.5 Time planning

N/A

C.2.6 Risks.

N/A

C.2.7 Errors and Observation handling

N/A

C.3 Analysis Specification

C.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

C.3.2 Analysis method

N/A

C.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

Appendix D
Verification Exercise EXE-15.04.05.a-TS.0022.0003 - GS Update interval for non-changing ADS-B items

D.1Exercise Scope and Justification

D.1.1 Exercise Level

The level of the exercise is Performance.

D.1.2 Exercise Type

The type of this exercise is Test.

D.1.3Description of the system being addressed

ADS–B Ground Station.

D.1.4 Context of the verification exercise

This document is applied to FAT (Factory Acceptance Test).

D.1.5 Required Datasets

1090 MHz Extended Squitter Messages input and 1090 GS ASTERIX output, containing at least 500,000 ADS–B messages from targets under study

D.1.6 Verification objectives

Verify that the update interval of the 1090 ES Ground Station for non-changing ADS-B items for Mobiles on the airport surface Manoeuvring, is 20 seconds at a probability of at least 90%.The non-changing items of relevance to this requirement are emitter category, aircraft length/width codes and GNSS antenna offset.

OBJ-15.04.05.a-TS.0022.0003
The aim of this objective is to check that the update interval for non-changing ADS-B items (emitter category, aircraft length/width codes and GNSS antenna offset) for Mobiles on the airport surface Manoeuvring Area is 20 seconds at a probability of at least 90%

D.1.7 Inputs

Surface ADS-B targets containing all kind of surface position messages (FTC 5-8). At least 500,000 ADS–B messages should be analized.

D.1.8 Outputs

Recorded Data.

D.1.9Entrance criteria

Start the generation of ADS–B messages.

D.1.10 Exit Criteria

The Test will finish after the generation of all messages foreseen in the input.

D.1.11 Exercise procedure

Exercise ID/TitleEXE-15.04.05.a-TS.0022.0003/ GS Update interval for non-changing ADS-B items

Pass Criteria: The test is passed if it is possible to verify that the update interval for non-changing ADS-B items is at least 20 seconds at a probability of at least 90%.

Exercise Type: Test

Precondition(s): - The test equipment setup will be in line with it described in Section D.1.13 (see below), with FRUIT generator enabled.
- The scenario consists of generating at least 500,000 ADS–B messages in Ground Station"s Input and FRUIT.

Step 1:

This test procedure verifies that the update interval for non-changing ADS-B items (emitter category, aircraft length/width codes and GNSS antenna offset) in environment without Mode A/C or Mode S FRUIT is 20s with a probability of 90%.

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class: –84 dBm for A3 equipment class.

The scenario shall be done with 100 a/c (100 different Mode S addresses). All of the 100 aircrafts shall transmit fixed different values of emitter category, aircraft length/width codes and GNSS antenna offset).

Step 2:

This test procedure verifies that the update interval for non-changing ADS-B items (emitter category, aircraft length/width codes and GNSS antenna offset) in environment with Mode A/C FRUIT is 20s with a probability of 90%.

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class:–84 dBm for A3 equipment class.

Set the power level of three Mode A/C FRUIT sources at the receiver input to the value corresponding to the UUT equipment class:-76, -72 and –68 dBm for A3 equipment class.

Activate the Mode A/C FRUIT source so that the FRUIT is pseudo randomly distributed across the Extended Squitter preamble and data block as specified in §2.4.4.4.2.1 of DO-260B.

The scenario shall be done with 100 a/c (100 different Mode S addresses). All of the 100 aircrafts shall transmit fixed different values of emitter category, aircraft length/width codes and GNSS antenna offset).

Step 3:

This test procedure verifies that the update interval for non-changing ADS-B items (emitter category, aircraft length/width codes and GNSS antenna offset) in environment with Mode S FRUIT is 20s with a probability of 90%.

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment

class plus 12 dB: –72 dBm for A3 equipment class.

Set the power level of Mode S FRUIT sources at the receiver input to the value corresponding to the UUT equipment class: -80 dBm for A3 equipment class.

Activate the Mode S FRUIT source so that the Mode S FRUIT is pseudo randomly distributed across the data Extended Squitter data block as specified in §2.4.4.4.2.1.2 of DO-260B.

The scenario shall be done with 100 a/c (100 different Mode S addresses). All of the 100 aircrafts shall transmit fixed different values of emitter category, aircraft length/width codes and GNSS antenna offset).

Note(s): The recorded data has to contain all kind of surface messages.

Device(s) in use:
- Ground Station ADS B
- Input Source for FRUIT and ADS-B Messages.
- ASTERIX Recording Tool
- Power
- UTC time Reference

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the 1090 GS in the default configuration.			
2	In the 1090 GS select Data driven reporting mode			
3	Configure the recording tool to capture ASTERIX reports coming from the ADS-B GS.			
4	Prepare the message source to play the scenario			
5	Inject the Target messages and FRUIT messages into the 1090 ES Ground Station			
6	Allow the recording to run for sufficient time to record the 500,000 messages.			
7	Stop the recording.			
8	From data recorded,			

verify the update time of the non-changing ADS-B items. Isolate this kind of messages and verify that the update time is 20 seconds at least in the 90% of the messages.			

Exercise result:

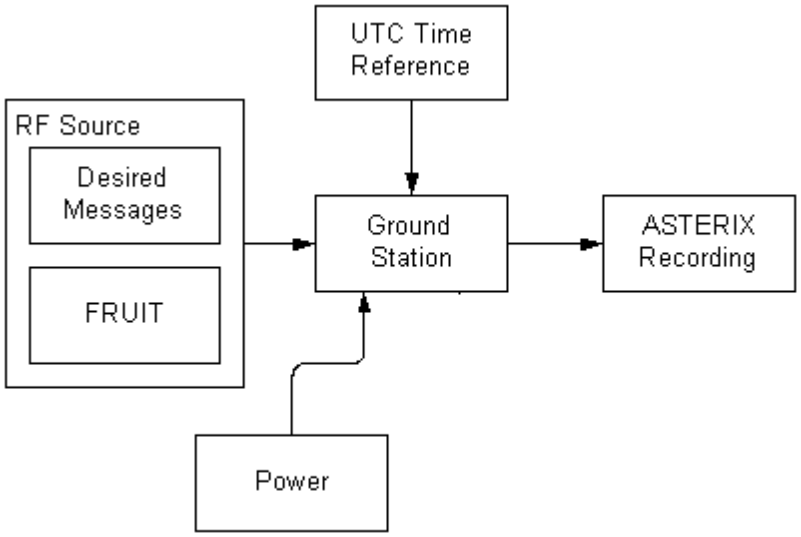
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 7: Verification Exercise Result

D.1.12 Verification SUT requirements

N/A

D.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

-Ground Station ADS–B

-RF Source for ADS –B Message

-ASTERIX Recording Tool

-Power

-UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports.

RF Source of Desired Messages

The RF Source of Desired Messages will be capable to generate the Desired1090 MHz messages in accordance with the Standard DO 260 – DO 260A – DO 260B.

RF Source of FRUIT

The RF Source of FRUIT will be capable of producing Mode A/C, Mode S short and Mode S long messages randomly distributed in time.

UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

D.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

D.1.15 Platform Configuration

N/A

D.1.16 Configuration(s) Identification of the Verification Platform

N/A

D.1.17 Links to other Verification Exercises

N/A

D.1.18 Representatively level/ limitations

N/A

D.2 Exercises Planning and management

D.2.1 Activities

D.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and D.1.13 in order to meet the Test Preconditions

D.2.1.2Execution activities

Play the scenario generating in the input the Desired 1090 MHz messages and record the relevant ASTERIX output.

D.2.1.3 Post execution activities

Isolate the information reported in the recorded ASTERIX Report to be able to validate the update period for non-changing ADS-B items. This update period shall be be 20 seconds at a probability of at least 90%.

D.2.2 Human Resources

N/A

D.2.3 Responsibilities in the exercise

N/A

D.2.4 Training

N/A

D.2.5 Time planning

N/A

D.2.6 Risks

N/A

D.2.7 Errors and Observation handling

N/A

D.3 Analysis Specification

D.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after the test execution, the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in input.

D.3.2 Analysis method

N/A

D.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 and ASTERIX CAT 23 item.

Appendix E
Verification Exercise EXE-15.04.05.a-TS.0022.0004- GS Changing Identity Information on the airport surface Manoeuvring Area

E.1Exercise Scope and Justification

E.1.1 Exercise Level

The level of the exercise is functional.

E.1.2 Exercise Type

The type of the exercise is Test.

E.1.3 Description of the system being addressed;

ADS–B Ground Station.

E.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

E.1.5 Required Datasets

1090 MHz Extended Squitter Messages input and 1090 GS ASTERIX output, containing at least 500,000 ADS–B messages from targets under study.

E.1.6 Verification objectives

Verify the Requirements related to the ADS-B APT Performance Requirements, more specifically, the following requirement:

OBJ-15.04.05.a-TS.0022.0004
The update interval for changing Identity Information on the airport surface Manoeuvring Area is 20 seconds at a probability of at least 90%.

E.1.7Inputs

A number of targets in order to simulate the maximum Ground Station's load in accordance to ADS-B APT Scenario. . At least 500,000 ADS–B messages should be analized.

E.1.8Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system 'Raw data output' reports.

E.1.9 Entrance criteria

Start the generation of input data.

E.1.10 Exit Criteria

Finished recording and performed analysis.

E.1.11 Exercise procedure

Exercise ID/TitleEXE-15.04.05.a-TS.0022.0004 **/** GS Changing Identity Information on the airport surface Manoeuvring Area

Pass Criteria:	This test is passed, when the recorded output has data items and corresponding values as expected.
Exercise Type:	Test
Precondition(s):	• Test equipment is setup as described above • GS under test is active, and ready for test.
Note(s):	N/A
Device(s) in use:	SUT is ADS-B GS.

This test procedure verifies that the 1090 ES Ground Station is able to detect a change of Identity code provided by the ADS-B aircraft and to produce a target report containing updated Identity data associated with any aircraft on the airport surface Manoeuvring Area and received from the a/c within the last 20 seconds with a probability of 90%.

In order to test the ability to produce a target report, test steps to be done are without FRUIT, with Mode A/C FRUIT overlapping, and with Mode S FRUIT overlapping.

Step 1:

This test procedure verifies that the 1090 ES Ground Station is able to detect a change of Identity code provided by the ADS-B aircraft and to produce a target report containing updated Identity data associated with any aircraft on the airport surface Manoeuvring Area and received from the a/c within the last 20 seconds in environment without Mode A/C or Mode S FRUIT with a probability of 90%.

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class:

–84 dBm for A3 equipment class.

The scenario shall be done with 100 a/c (100 different Mode S addresses). All a/c shall have 100 different Identity codes, which are updated to the new values. ASTERIX output shall be recorded. Compare the output with the known content of the injected input. Any differences that are detected are recorded as an undetected error and that squitter reception is deleted from the count of error free receptions. Additionally compare time of received input with the time when corresponding ASTERIX report was generated.

Calculate the measured probability that difference between time of reception and time of output with changed Identity is not greater than 20 seconds in 90% cases.

Step 2:

This test procedure verifies that the 1090 ES Ground Station is able to detect a change of Identity code provided by the ADS-B aircraft and to produce a target report containing updated Identity data associated with any aircraft on the airport surface Manoeuvring Area and received from the a/c within the last 20 seconds in environment with Mode A/C FRUIT with a probability of 90%.

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class:

–84 dBm for A3 equipment class.

Set the power level of three Mode A/C FRUIT sources at the receiver input to the value corresponding to the UUT equipment class:

-76, -72 and –68 dBm for A3 equipment class.

Activate the Mode A/C FRUIT source so that the FRUIT is pseudo randomly distributed across the Extended Squitter preamble and data block as specified in §2.4.4.4.2.1 of DO-260B.

The scenario shall be done with 100 a/c (100 different Mode S addresses). All a/c shall have 100 different Identity codes, which are updated to the new values. ASTERIX output shall be recorded. Compare the output with the known content of the injected input. Any differences that are detected are recorded as an undetected error and that squitter reception is deleted from the count of error free receptions. Additionally compare time of received input with the time when corresponding ASTERIX report was generated.

Calculate the measured probability that difference between time of reception and time of output with changed Identity is not greater than 20 seconds in 90% cases.

Step 3:

This test procedure verifies that the 1090 ES Ground Station is able to detect a change of Identity provided by the ADS-B aircraft and to produce a target report containing updated Identity data associated with any aircraft on the airport surface Manoeuvring Area and received from the a/c within the last 20 seconds in environment with Mode S FRUIT with a probability of 90%.

Connect the Extended Squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class plus 12 dB:

–72 dBm for A3 equipment class.

Set the power level of Mode S FRUIT sources at the receiver input to the value corresponding to the UUT equipment class:

-80 dBm for A3 equipment class.

Activate the Mode S FRUIT source so that the Mode S FRUIT is pseudo randomly distributed across the data Extended Squitter data block as specified in §2.4.4.4.2.1.2 of DO-260B.

The scenario shall be done with 100 a/c (100 different Mode S addresses). All a/c shall have 100 different Identity codes, which are updated to the new values. ASTERIX output shall be recorded. Compare the output with the known content of the injected input. Any differences that are detected are recorded as an undetected error and that squitter reception is deleted from the count of error free receptions. Additionally compare time of received input with the time when corresponding ASTERIX report was generated.

Calculate the measured probability that difference between time of reception and time of output with changed Identity code is not greater than 20 seconds in 90% cases.

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system			

	ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

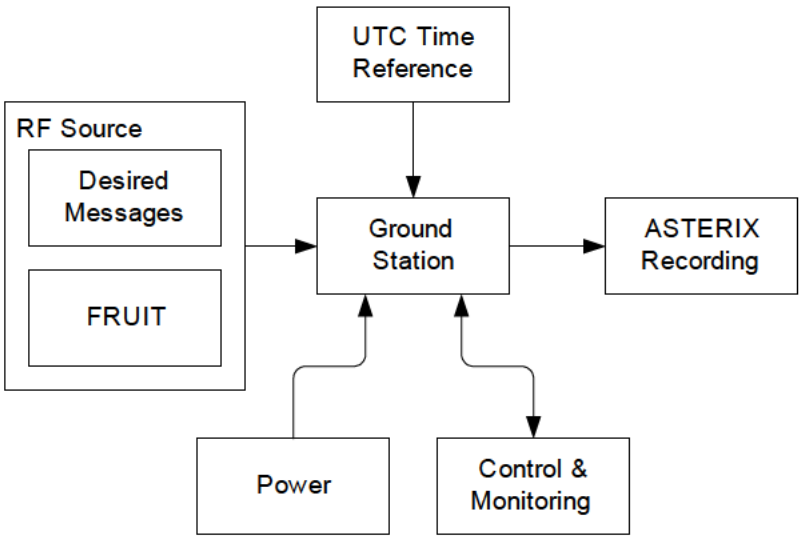
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 8: Verification Exercise Result

E.1.12 Verification SUT requirements

N/A

E.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS–B
- RF Source for ADS –B Message
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference.

The Item reported above will be capable to perform the functionalities reported below.

Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

RF Source of Desired Messages

The RF Source of Desired Messages will be capable to generate the Desired1090 MHz messages in accordance with the Standard DO 260 – DO 260A – DO 260B.

RF Source of FRUIT

The RF Source of FRUIT will be capable of producing Mode A/C, Mode S short and Mode S long messages randomly distributed in time.

UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

E.1.14 Verification Platform needs

See section 3.5 Verification Platform needs.

E.1.15 Platform Configuration

N/A

E.1.16 Configuration(s) Identification of the Verification Platform

N/A

E.1.17 Links to other Verification Exercises

N/A

E.1.18 Representatively level/ limitations

N/A

E.2 Exercises Planning and management

E.2.1 Activities

E.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and E.1.13 in order to meet the Test Preconditions.

E.2.1.2 Execution activities

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

E.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

E.2.2 Human Resources.

N/A

E.2.3 Responsibilities in the exercise

N/A

E.2.4 Training

N/A

E.2.5 Time planning

N/A

E.2.6 Risks.

N/A

E.2.7 Errors and Observation handling

N/A

E.3 Analysis Specification

E.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

E.3.2 Analysis method

N/A

E.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

Appendix F
Verification Exercise EXE-15.04.05.a-TS.0022.0005 - GS Integrity and continuity failure in APT environment

F.1Exercise Scope and Justification

F.1.1 Exercise Level

The level of the exercise is functional.

F.1.2 Exercise Type

The type of this exercise is Test

F.1.3 Description of the system being addressed;

ADS–B Ground Station.

F.1.4 Context of the verification exercise

This document is applied to FAT (Factory Acceptance Test).

F.1.5 Required Datasets

1090 MHz Extended Squitter Messages input and 1090 GS ASTERIX output, containing at least 2000 ADS–B messages.

F.1.6 Verification objectives

Verify that the decoder undetected message error rate is better than 1 in 10^3 messages (1 in 2000 for GS and 1 in 2000 for SDPD).

OBJ-15.04.05.a-TS.0022.0005
The aim of this objective is to check that the probability of the Ground Domain system integrity failure is 1.00E-03 or less per hour

OBJ-15.04.05.a-TS.0022.0006
The aim of this objective is to check that the probability of the Ground Domain system continuity failure is 1.00E-03 or less per hour.

F.1.7Inputs

At least 2000 ADS–B messages.

F.1.8 Outputs

Recorded Data.

F.1.9 Entrance criteria

Start the generation of 2000 ADS–B messages.

F.1.10 Exit Criteria

The Test will finish after the generation of all messages foreseen in the input.

F.1.11Exercise procedure

Exercise ID/Title: EXE-15.04.05.a-TS.0022.0005 / GS Integrity and continuity failure in APT environment

Pass Criteria: The test is passed if it is possible to verify that the 1090 GS integrity match the following condition: the decoder undetected message error rate shall be better than 1 in 10^3 messages.

An undetected message error is assumed for the purposes of this test to be one which results in an error in either a position or a position quality field in an ASTERIX Category 021 position report.

Exercise Type: Test

Precondition(s):

-The test equipment setup will be in line with it described in Section F.1.13 (see below), with FRUIT generator enabled.
-The scenario consists of generating at least 2000 ADS–B messages in Ground Station's Input.
-Power is on.

Note(s): -The recorded data may contain data received from real aircraft in the vicinity. This extra data may be ignored.

Device(s) in use: ADS– Ground Station
Input Source for Fruit and ADS –B Messages.
ASTERIX Recording Tool
Power
UTC time Reference.

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Enable the injection of the valid aircraft			
2	Start the FRUIT generator.			
3	Allow the recording to run for sufficient time to record at least 2000 messages.			
4	Stop the recording.			
5	By comparison of the recorded data against the known aircraft positions, confirm that no more than 1 in 1000 position reports contain either an incorrect position (I021/130, I021/145) or incorrect position quality	No more than 1 in 1000 position reports contain either an incorrect position (I021/130, I021/145) or incorrect position quality values (I021/090).		

values (I021/090).				

Exercise result:

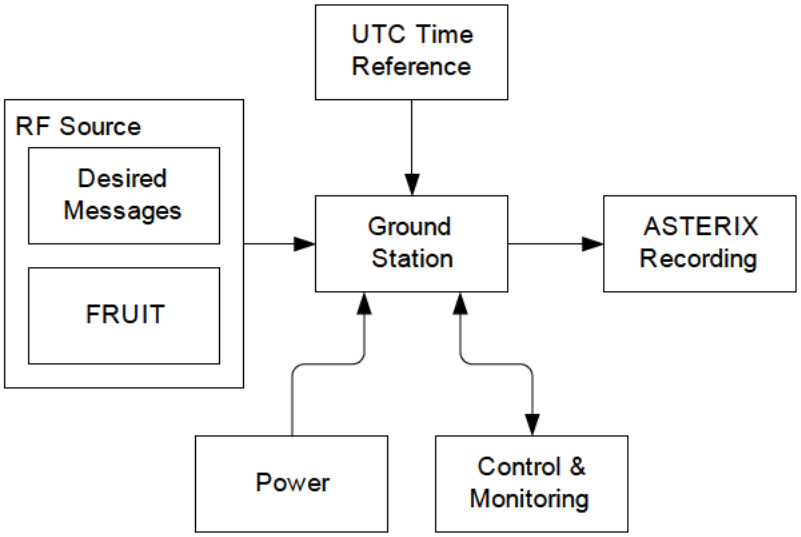
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 9: Verification Exercise Result

F.1.12 Verification SUT requirements

N/A

F.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS–B
- RF Source for Fruit and ADS –B Message
- ASTERIX Recording Tool
- Power
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports.

RF Source of Desired Messages

The RF Source of Desired Messages will be capable to generate the Desired1090 MHz messages in accordance with the Standard DO 260 – DO 260A – DO 260B.

RF Source of FRUIT

The RF Source of FRUIT will be capable of producing Mode A/C, Mode S short and Mode S long messages randomly distributed in time.

UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

The Verification Technique consists in the comparison of the recorded data against the known aircraft positions, confirming that no more than 1 in 100,000 position reports contains either an incorrect position (I021/130, I021/145) or an incorrect position quality values (I021/090).

F.1.14 Verification Platform needs

See section 3.5.

F.1.15 Platform Configuration

N/A

F.1.16 Configuration(s) Identification of the Verification Platform

N/A

F.1.17 Links to other Verification Exercises

N/A

F.1.18 Representatively level/ limitations

N/A

F.2 Exercises Planning and management

F.2.1 Activities

N/A

F.2.1.1 Preparatory activities

Set up the tools/equipment listed in 3.5 and F.1.13 in order to meet the Test Preconditions.

F.2.1.2 Execution activities

Play the scenario generating in the input the desired 1090 MHz messages and record the relevant ASTERIX output.

F.2.1.3 Post execution activities

Verify that the information reported in the recorded ASTERIX Report is consistent with the input messages. In fact by means of comparison of the recorded data against the known aircraft positions it

should be possible to confirm that no more than 1 in 100,000 position reports contain either an incorrect position (I021/130, I021/145) or an incorrect position quality values (I021/090).

F.2.2 Human Resources.

N/A

F.2.3 Responsibilities in the exercise

N/A

F.2.4 Training

N/A

F.2.5 Time planning

N/A

F.2.6 Risks.

N/A

F.2.7 Errors and Observation handling

N/A

F.3 Analysis Specification

F.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after the test execution, the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in input.

F.3.2 Analysis method

N/A

F.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 and ASTERIX CAT 23 item.

Appendix G
Verification Exercise EXE-15.04.05.a-TS.0030.0001 - GS WAM Integrity Check

G.1Exercise Scope and Justification

G.1.1 Exercise Level

The level of the exercise is functional.

G.1.2Exercise Type

The type of this exercise is Test.

G.1.3Description of the system being addressed

ADS–B Ground Station.

G.1.4Context of the verification exercise

This document is applied to FAT (Factory Acceptance Test)

G.1.5Required Datasets

The Datasets foreseen for this exercise are:

ADS–B messages in the input of the Ground Station.

ASTERIX report CAT20 for the WAM System.

ASTERIX report CAT19 for the WAM System.

G.1.6Verification objectives

Verify the Requirements related to the enhancement of WAM integrity Check.

OBJ-15.04.05.a-TS.0030.0101
The aim of this objective is to check that the ADS-B Ground Surveillance Domain processes and decodes received WAM data in ASTERIX CAT020. In addition to data specified in Iteration 1, the following minimum data item are decoded: ▪ Measured Height ▪ Mode-S MB Data ▪ Calculated Track Velocity

OBJ-15.04.05.a-TS.0030.0102
The aim of this objective is to check that the ADS-B Ground Surveillance Domain is able to manage the case of WAM reports with duplicated Mode S addresses during the phase of correlation of ADS-B reports with WAM reports

OBJ-15.04.05.a-TS.0030.0103
The aim of this objective is to check that the ADS-B Ground Surveillance Domain is able to check the integrity of the barometric altitude reported in ADS-B reports through the WAM data.

OBJ-15.04.05.a-TS.0030.0104
The aim of this objective is to check that the ADS-B Ground Surveillance Domain is able to report the WAM Altitude Consistency validation result in the ASTERIX CAT021 ADS-B report.

OBJ-15.04.05.a-TS.0030.0107
The aim of this objective is to check that the ADS-B Ground Surveillance Domain is able to perform a cross check between data in ADS-B report received through 1090 ES and Mode S enhanced data in WAM reports.

OBJ-15.04.05.a-TS.0030.0108
The aim of this objective is to check that the ADS-B Ground Surveillance Domain is able to report the WAM Mode S Enhanced Data validation result in the ASTERIX CAT021 ADS-B report

OBJ-15.04.05.a-TS.0030.0111
The aim of this objective is to check that the ADS-B Ground Surveillance Domain is able to check the integrity of the velocity reported in ADS-B reports through the WAM data.

OBJ-15.04.05.a-TS.0030.0112
The aim of this objective is to check that the ADS-B Ground Surveillance Domain is able to report the WAM Velocity validation result in the ASTERIX CAT021 ADS-B report

G.1.7Inputs

The foreseen inputs for this exercise are:

ADS-B messages in the Ground Station Input.

ASTERIX report CAT20 for the WAM System

ASTERIX report CAT19 for the WAM System.

G.1.8Outputs

ASTERIX report recording.

G.1.9Entrance criteria

Start the generation of input data.

G.1.10Exit Criteria

The Test will finish after the generation and injection of input data and recording of output data.

G.1.11Exercise procedure

Exercise ID/Title: EXE-15.04.05.a-TS.0030.0001 **/** GS WAM Integrity Check

Pass Criteria: The test is passed if the conditions described in the different scenarios are verified.

Exercise Type: Test

Precondition(s): The test equipment setup will be in line with that described in Section G.1.13 (see below).

It will be simulated that the GS performs correctly the WAM integrity check and that the ADS-B Ground Surveillance Domain is able to report the validation result in the ASTERIX CAT021 ADS-B report.

It will be simulated the following input:

- o ADS–B input messages in the Ground Station referring to an aircraft with a specific 24 – bit Address.
- o ASTERIX CAT20 reports in input of Ground Station referring to an aircraft with the same 24 bits Address used for the ADS–B input messages.
- o ASTERIX CAT 19 reports from the WAM system

During the test execution the following ADS-B input messages (all referring to the same aircraft) will be generated:

- Airborne position message
- Velocity message, subtype 1,2
- Velocity message, subtype 3,4
- Surface position message
- State and Status message

The ADS–B messages and the correspondent ASTERIX CAT20 will be set in order to have the following results from the integrity check:

	Cat19 Bit NOGO	Position Test result	Velocity Test result	Altitude Test Result	Mode S Test Result	ATX WAI bits
Step 1	00	Not Validated	Consistent	Consistent	Consistent	01
Step 2	00	Consistent	Suspicious	Consistent	Consistent	01
Step 3	00	Consistent	Consistent	Suspicious	Consistent	01
Step 4	00	Consistent	Consistent	Consistent	Suspicious	11
Step 5	00	Consistent	Consistent	Consistent	Consistent	00
Step 7	11/10/01	Not performed	Not performed	Not performed	Not performed	10

It will be simulated that the GS performs correctly the WAM integrity check and that the ADS-B Ground Surveillance Domain is able to report the validation result in the ASTERIX CAT021 ADS-B report.

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the 1090 GS in the default configuration.			
2	In the 1090 GS, activate the ADS-B/WAM Integrity check.			
3	Set the parameter Time Out Parameter for ASTERIX 19 reception = XX seconds			
4	Set the parameter ADS-B/WAM Position Threshold = ZZZ meters.			
5	Set the parameter BaroAltitude_vs_MeasHeight Threshold = ZZZ feet.			
6	Set the parameter GroundSpeed_vs_CalulatedVelocity Threshold = ZZZ knots.			
7	Set the parameter Direction_vs_TrueTrackAngle Threshold = ZZZ degrees.			
8	Set the parameter Velocity_vs_GroundSpeed Threshold = ZZZ knots.			
9	Set the parameter ADS-B_vs_WAM TrueAirSpeed Threshold = ZZZ knots.			
10	Set the parameter ADS-B_vs_WAM IndicatedAirSpeed Threshold = ZZZ knots.			
11	Set the parameter ADS-B_vs_WAM MagneticHeading Threshold = ZZZ degrees.			
12	Set the parameter BaroVerticalRate_vs_BaroAltitudeRate Threshold = ZZZ feet/min.			
13	Set the parameter HeadingGround_vs_TrueTrackAngle Threshold = ZZZ degrees.			
14	Set the parameter Movement_vs_GroundSpeed Threshold = ZZZ knots.			

15	Set the parameter HeadingGround_ vs_MagneticHeading Threshold = ZZZ degrees.			
16	Set the parameter ADS-B/WAM SelectedAltitude = ZZZ feet.			
17	Set the parameter ADS-B/WAM BaroPressure = ZZZ bars.			
18	Prepare the report capture tool to capture ASTERIX reports	Recording tool is receiving data from ADS-B GS		
19	Play the scenario in the injection tool.	Recording tool is receiving data from ADS-B GS corresponding to test targets.		
20	When the scenario is complete, stop recording ASTERIX reports			
21	Analyze the recorded data and verify that the expected outputs are present.			

Exercise result:

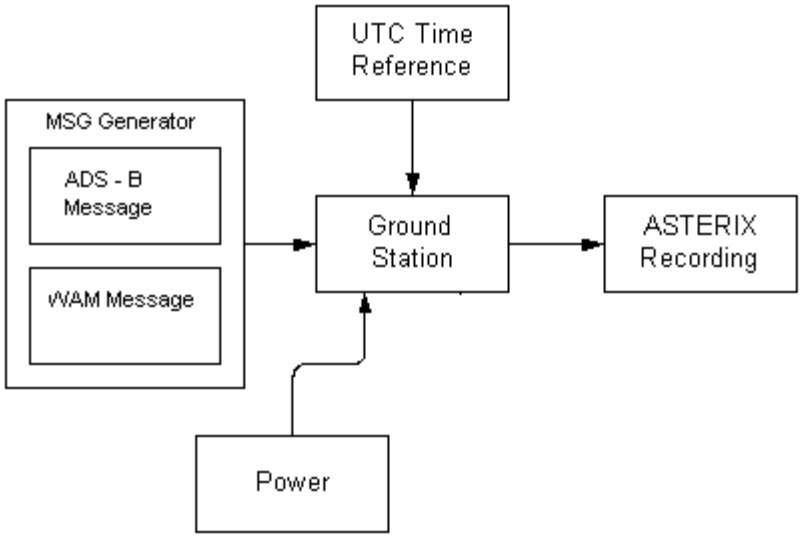
Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

G.1.12 Verification SUT requirements

N/A

G.1.13 Exercise Tool, Verification Technique and/or Platform

The Verification Technique consists in the verification from the recorded data that validation information (VALID, VALID EXCEPT MODE S DATA, NOT VALID, NOT VALIDATED) are correctly propagated over ASTERIX CAT 21 in each scenario reported in the section



The Exercise will be verified in a platform with the following foreseen tools/equipment:

-Ground Station ADS–B

-Message Generator

-ASTERIX Recording Tool

-Power

-UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports.

Message Generator

The Messages Generator will be capable to generate the ADS–B messages , ASTERIX CAT20 messages and ASTERIX CAT 19 messages.

UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

G.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

G.1.15 Platform Configuration

N/A.

G.1.16 Configuration(s) Identification of the Verification Platform

N/A.

G.1.17 Links to other Verification Exercises

N/A.

G.1.18 Representatively level / limitations

N/A.

G.2 Exercises Planning and management

N/A.

G.2.1 Activities

G.2.1.1Preparatory activities

Setup the tools/equipment listed in G.1.13 in order to meet the Test Preconditions

G.2.1.2 Execution activities

Play the scenario generating in the input the Desired messages and record the relevant ASTERIX output.

G.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports during the application of each Scenario above. The Recorded ASTERIX reports will be analyzed in order to verify the right information propagation as requested in each Test Scenario.

G.2.2 Human Resources.

N/A.

G.2.3Responsibilities in the exercise

N/A.

G.2.4Training

N/A.

G.2.5Time planning

N/A.

G.2.6Risks.

N/A.

G.2.7Errors and Observation handling

N/A.

G.3Analysis Specification

G.3.1 Data collection methods

The data's collection during the test will be Qualitative.

G.3.2 Analysis method

N/A.

G.3.3Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 and ASTERIX CAT 23 item.

Appendix H
Verification Exercise EXE-15.04.05.a-TS.0040.0040 - GS Time Differential of Arrival Validation

H.1Exercise Scope and Justification

H.1.1 Exercise Level

The level of the exercise is functional.

H.1.2 Exercise Type

The type of the exercise is Test.

H.1.3 Description of the system being addressed;

ADS–B Ground Station.

H.1.4 Context of the verification exercise

This document is applied to FAT (Factory Acceptance Test).

H.1.5 Required Datasets

The Datasets foreseen for this exercise are:

N Target data streams coming from Remote Systems.

N Operational Status Data Streams coming from Remote Systems.

H.1.6 Verification objectives

Verify the Requirements related to the TDOA Validation Test.

OBJ-15.04.05.a-TS.0040.0140
The aim of this objective is to check that the ADS-B Ground Surveillance Domain is able to calculate for each received ADS-B position message the relative TDOA.

OBJ-15.04.05.a-TS.0040.0142
The aim of this objective is to check that the ADS-B Ground Surveillance Domain is able to process the TDOA in order to validate the position information extracted from the position message

OBJ-15.04.05.a-TS.0040.0144
The aim of this objective is to check the ADS-B Ground Surveillance Domain is able to report the TDOA validation result in the ASTERIX CAT021 ADS-B report

H.1.7 Inputs

The Dataset foreseen for this exercise are:

N Target data streams coming from Remote Systems.

N Operational Status Data Streams coming from Remote Systems.

H.1.8 Outputs

ASTERIX Report Recording

H.1.9 Entrance criteria

Start the generation of input data.

H.1.10 Exit Criteria

The Test will finish after the generation and injection of the input data and recording of the output data.

H.1.11 Exercise procedure

Exercise ID/Title: EXE-15.04.05.a-TS.0040.0040 / GS Time Differential of Arrival Validation

Pass Criteria: The test is passed if it is possible to generate the Time Differential Of Arrival (TDOA) hyperboloid from the TOAs associated with the same 1090 ES position message, and to validate the message through the distance between the ADS-B 3D position and the corresponding TDOA hyperboloid.

Exercise Type: Test

Precondition(s): **The following Scenarios will be simulated:**

Scenario 1

It will be simulated that the Time Out for System Operational Status Data Stream for one Remote System expires, with the corresponding Target Data Stream excluded by the Validity Check.

The following input will be simulated:

2 Target Data Streams coming from different Remote Systems

1 Operational Status Data Streams coming from one Remote Systems

In this case, it will be verified that:

After Time out expiration the relevant information is propagated over ASTERIX CAT 23.

Until the condition above persists, it is NOT possible to perform the TDOA Validation with the 1090 GS report marked as “TDOA NOT VALIDATED” over ATX21. The test above isn’t performed because the scenario foresees only 2 (two) remote system Target Data Streams and one will be excluded in the computation because the relevant Operational Status Data Stream is not available.

Scenario 2

In this Scenario it will be simulated that when the operational status of one Remote System becomes not healthy, the relevant Target Data Stream is not used in the TDOA Validation.

The following input will be simulated:

2 Target Data Streams coming from remote systems

2 Operational Status Data Streams coming from remote systems with one Operational Data Streams set in order to simulate the transition between Healthy status to Not Healthy status in the Remote System. The transmitted ADS-B position will be set in order to perform correctly the TDOA validation and to mark the ADS-B report as “VALID”.

Taking into account that we have in configuration only 2 (two) remote system it will be verified that:

Until the Status of both remote system are declared as healthy the TOA/DISTANCE Check will be performed and the 1090 GS report will be marked as VALID.

After that Operational Status of one Remote System become NOT healthy the 1090 GS report is marked as NOT VALIDATED over ATX21 (as only one healthy data stream is available).

Scenario 3

In this Scenario it will be simulated that if the ADS-B transmitted position of the aircraft becomes not accurate the TDOA Validation function marks the ADS-B report as “TDOA NOT VALID”.

The following input will be simulated:

2 Target Data Streams coming from remote systems

2 Healthy Operational Status Data Streams coming from remote systems.

The test target moves respect to sensor (approach or away) transmitting a correct position until time “t1”.

Just after "t1", the target will start transmitting an offset position until the end of the test. The position offset will be large enough to fail the TDOA Validation.

In the period of time between "t1" and the end of the test, in a certain moment, "t2" the target’s ADS-B report will be marked as “TDOA NOT VALID” over ASTERIX Cat.21.

Note(s):

In order to Perform the Exercise related to TOA versus Distance Validation are requested the following item in the System:

Central Server Function

n (with n >= 2) Remote Systems.

Each Remote System will be able to generate two different data stream:

Target data stream with inside the information extracted by the ADS–B message (ASTERIX CAT 21 in case of Ground Station or Raw Data in case the remote System is a 1090 MHz Receiver).

Operational Data Stream (ASTERIX CAT 23 in case of Ground Station or Raw Data referring to operational Status in case the remote System is a 1090 MHz Receiver).

Device(s) in use:

Ground Station ADS–B

Message Generator

ASTERIX Recording Tool

Power

UTC time Reference.

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the 1090 GS in the default configuration.			
2	In the 1090 GS, activate the TDOA versus distance validation.			
3	Set the parameter Time Out Parameter for Operational Status Data Stream = YY seconds			
4	Prepare the report capture tool to capture ASTERIX reports.			
5	Prepare the message source to play the scenario			
6	For each scenario: -Play the scenario. -When the scenario is complete, stop			

recording ASTERIX reports. -Analyze the recorded data and verify that the conditions described above are met			

Exercise result:

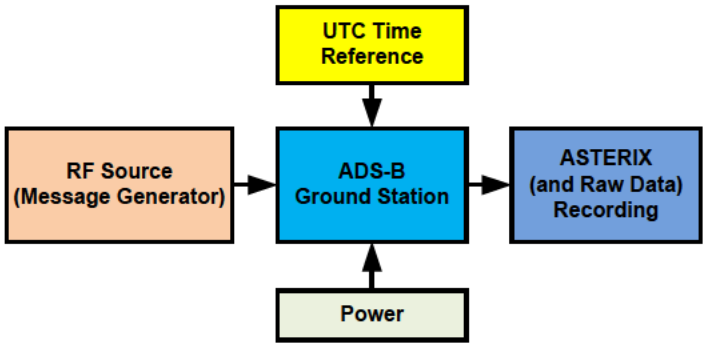
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 10: Verification Exercise Result

H.1.12 Verification SUT requirements

N/A

H.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

-Ground Station ADS–B

-Message Generator

-ASTERIX Recording Tool

-Power

-UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports.

For this Exercise, the Ground Station ADS-B has to be provided with a specific functionality in order to perform a Central Processing (Central Processing Server) of Data coming from a lot of Remote Systems (ADS–B Ground Station or 1090 Receiver).

Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS–B Ground Station or 1090 Receiver) like:

Target data stream with inside the information extracted by the ADS–B message (ASTERIX CAT 21 in case of Ground Station or Raw Data in case the remote System is a 1090 MHz Receiver).

Operational Data Stream with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in case of Ground Station or Raw Data in case the remote System is a 1090 MHz Receiver).

UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

H.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

H.1.15 Platform Configuration

N/A

H.1.16 Configuration(s) Identification of the Verification Platform

N/A

H.1.17 Links to other Verification Exercises

N/A

H.1.18 Representatively level/ limitations

N/A

H.2 Exercises Planning and management

H.2.1 Activities

N/A

H.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and H.1.13 in order to meet the Test Preconditions.

H.2.1.2 Execution activities

Play the scenario generating in the input the desired messages and record the relevant ASTERIX output.

H.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX report during the application of each Scenario above. The Recorded ASTERIX report will be analyzed in order to verify the right information propagation as requested in each Test Scenario.

H.2.2 Human Resources

N/A

H.2.3 Responsibilities in the exercise

N/A

H.2.4 Training

N/A

H.2.5 Time planning

N/A

H.2.6 Risks

N/A

H.2.7 Errors and Observation handling

N/A

H.3 Analysis Specification

H.3.1 Data collection methods

The data's collection during the test will be Qualitative.

H.3.2 Analysis method

N/A

H.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 and ASTERIX CAT 23 item.

Appendix I
Verification EXE-15.04.05.a-TS.0040.0080 - GS Track Behaviour Analysis

I.1 Exercise Scope and Justification

I.1.1 Exercise Level

The level of the exercise is functional.

I.1.2 Exercise Type

The type of the exercise is Test.

I.1.3 Description of the system being addressed

ADS–B Ground Station.

I.1.4 Context of the verification exercise

This document is applied to FAT (Factory acceptance Test).

I.1.5 Required Datasets

1090 MHz Extended Squitter Messages input and 1090 GS ASTERIX output.

I.1.6 Verification objectives

Verify the Requirements related to the enhancement 1090ES Technology.

OBJ-15.04.05.a-TS.0040.0080
The aim of this objective is to check that the ADS-B Ground Surveillance system validates the track consistency evaluating track behaviour (values and changes of specific a/c attributes to be verified). ***Note:*** *Those specific attributes are: velocity, acceleration, heading, altitude, and vertical rate.*

OBJ-15.04.05.a-TS.0040.0082
The aim of this objective is to check that the ADS-B Ground Surveillance system has a set of configurable ranges for each attribute behaviour to be verified based on “ADS-B Emitter Category SET” Code Definitions. ***Note:*** *Those specific attributes are: velocity, vertical rate, altitude, acceleration, and heading.*

OBJ-15.04.05.a-TS.0040.0084
The aim of this objective is to check that, based on received “ADS-B Emitter Category SET” Code Definitions, the ADS-B Ground Surveillance system verifies the track behaviour against predefined valid configurable attribute ranges for each item independently. ***Note:*** *Those specific attributes are: velocity, acceleration, heading, altitude, and vertical rate.*

OBJ-15.04.05.a-TS.0040.0086
The aim of this objective is to check that the ADS-B Ground Surveillance system issues the corresponding ATX Cat 021 report with the BAR bits set to adequate values based on the overall result of Track Consistency verification function. ***Note:*** *Track Consistency verification includes:* 3. *velocity versus position change (Iteration 1), and* 1. *track consistency evaluating track behaviour (velocity, vertical rate, altitude, acceleration, and heading) (Iteration 2)*

I.1.7Inputs

1090 MHz Extended Squitter Messages.

I.1.8 Outputs

Recordings of ASTERIX CAT-21 and, optionally, GS system 'Raw data output' reports.

I.1.9 Entrance criteria

Start the generation of the input data.

I.1.10 Exit Criteria

Finished recording and performed analysis.

I.1.11 Exercise procedure

Exercise ID/Title: EXE-15.04.05.a-TS.0040.0080 / GS Track Behaviour Analysis

Pass Criteria:	This test is passed, when the recorded output has data items and corresponding values as expected.
Exercise Type:	Test
Precondition(s):	• Test equipment is setup as described above • GS under test is active, and ready for test.
Note(s):	N/A
Device(s) in use:	SUT is ADS-B GS.

This test procedure verifies that the 1090 ES Ground Station is able to produce a target report containing information if track consistency evaluating track behaviour is performed, and if it is, if the result is: "Behaviour Not Validated", "Behaviour Not Valid", "Behaviour Valid" or "Behaviour Valid only for a test subset". All validations (velocity, vertical rate, altitude, acceleration, and heading) are performed.

Step 1:

This test step verifies that the 1090 ES Ground Station is not performing any consistency check (velocity, vertical rate, altitude, acceleration, and heading) because these functions are switched off.

Scenario simulates an ADS-B aircraft. Since consistency check track behaviour is switched off, all internal BAR values and BAR in ASTERIX reports of the target do not have information (NOT VALIDATED).

Step 2:

This test step verifies that the 1090 ES Ground Station is performing consistency check track behaviour (only Velocity) because this function is switched on.

Scenario simulates an ADS-B aircraft and simulated inputs do match expected track behaviour (Velocity is within the valid range based on “ADS-B Emitter Category SET”). Internal Velocity BAR value is set to VALID and ASTERIX reports of the target do have information (BAR= 11, VALID ONLY FOR A TEST SUBSET).

Step 3:

This test step verifies that the 1090 ES Ground Station is performing consistency check track behaviour (only Velocity) because this function is switched on.

Scenario simulates an ADS-B aircraft and simulated inputs do not match expected track behaviour (Velocity is out of the valid range based on “ADS-B Emitter Category SET”). Internal Velocity BAR value is set to NOT VALID and ASTERIX reports of the target do have information (BAR= 01, NOT VALID).

Step 4:

This test step verifies that the 1090 ES Ground Station is performing consistency check track behaviour (only Acceleration) because this function is switched on.

Scenario simulates an ADS-B aircraft and simulated inputs do match expected track behaviour (Acceleration is within the valid range based on “ADS-B Emitter Category SET”). Internal Acceleration BAR value is set to VALID and ASTERIX reports of the target do have information (BAR= 11, VALID ONLY FOR A TEST SUBSET).

Step 5:

This test step verifies that the 1090 ES Ground Station is performing consistency check track behaviour (only Acceleration) because this function is switched on.

Scenario simulates an ADS-B aircraft and simulated inputs do not match expected track behaviour (Acceleration is out of the valid range based on “ADS-B Emitter Category SET”). Internal Acceleration BAR value is set to NOT VALID and ASTERIX reports of the target do have information (BAR= 01, NOT VALID).

Step 6:

This test step verifies that the 1090 ES Ground Station is performing consistency check track behaviour (only Acceleration Change) because this function is switched on.

Scenario simulates an ADS-B aircraft and simulated inputs do match expected track behaviour (Acceleration Change is within the valid range based on “ADS-B Emitter Category SET”). Internal Acceleration Change BAR value is set to VALID and

ASTERIX reports of the target do have information (BAR= 11, VALID ONLY FOR A TEST SUBSET).

Step 7:

This test step verifies that the 1090 ES Ground Station is performing consistency check track behaviour (only Acceleration Change) because this function is switched on.

Scenario simulates an ADS-B aircraft and simulated inputs do not match expected track behaviour (Acceleration Change is out of the valid range based on “ADS-B Emitter Category SET”). Internal Acceleration Change BAR value is set to NOT VALID and ASTERIX reports of the target do have information (BAR= 01, NOT VALID).

Step 8:

This test step verifies that the 1090 ES Ground Station is performing consistency check track behaviour (only Heading) because this function is switched on.

Scenario simulates an ADS-B aircraft and simulated inputs do match expected track behaviour (Heading is within the valid range based on “ADS-B Emitter Category SET”). Internal Heading BAR value is set to VALID and ASTERIX reports of the target do have information (BAR= 11, VALID ONLY FOR A TEST SUBSET).

Step 9:

This test step verifies that the 1090 ES Ground Station is performing consistency check track behaviour (only Heading) because this function is switched on.

Scenario simulates an ADS-B aircraft and simulated inputs do not match expected track behaviour (Heading is out of the valid range based on “ADS-B Emitter Category SET”). Internal Heading BAR value is set to NOT VALID and ASTERIX reports of the target do have information (BAR= 01, NOT VALID).

Step 10:

This test step verifies that the 1090 ES Ground Station is performing consistency check track behaviour (only Heading Change) because this function is switched on.

Scenario simulates an ADS-B aircraft and simulated inputs do match expected track behaviour (Heading Change is within the valid range based on “ADS-B Emitter Category SET”). Internal Heading Change BAR value is set to VALID and ASTERIX reports of the target do have information (BAR= 11, VALID ONLY FOR A TEST SUBSET).

Step 11:

This test step verifies that the 1090 ES Ground Station is performing consistency check track behaviour (only Heading Change) because this function is switched on.

Scenario simulates an ADS-B aircraft and simulated inputs do not match expected track behaviour (Heading Change is out of the valid range based on “ADS-B Emitter Category SET”). Internal Heading Change BAR value is set to NOT VALID and ASTERIX reports of the target do have information (BAR= 01, NOT VALID).

Step 12:

This test step verifies that the 1090 ES Ground Station is performing consistency check track behaviour (only Altitude) because this function is switched on.

Scenario simulates an ADS-B aircraft and simulated inputs do match expected track behaviour (Altitude is within the valid range based on “ADS-B Emitter Category SET”). Internal Altitude BAR value is set to VALID and ASTERIX reports of the target do have information (BAR= 11, VALID ONLY FOR A TEST SUBSET).

Step 13:

This test step verifies that the 1090 ES Ground Station is performing consistency check track behaviour (only Altitude) because this function is switched on.

Scenario simulates an ADS-B aircraft and simulated inputs do not match expected track behaviour (Altitude is out of the valid range based on “ADS-B Emitter Category SET”). Internal Altitude BAR value is set to NOT VALID and ASTERIX reports of the target do have information (BAR= 01, NOT VALID).

Step 14:

This test step verifies that the 1090 ES Ground Station is performing consistency check track behaviour (only Altitude Change) because this function is switched on.

Scenario simulates an ADS-B aircraft and simulated inputs do match expected track behaviour (Altitude Change is within the valid range based on “ADS-B Emitter Category SET”). Internal Altitude Change BAR value is set to VALID and ASTERIX reports of the target do have information (BAR= 11, VALID ONLY FOR A TEST SUBSET).

Step 15:

This test step verifies that the 1090 ES Ground Station is performing consistency check track behaviour (only Altitude Change) because this function is switched on.

Scenario simulates an ADS-B aircraft and simulated inputs do not match expected track behaviour (Altitude Change is out of the valid range based on “ADS-B Emitter Category SET”). Internal Altitude Change BAR value is set to NOT VALID and ASTERIX reports of the target do have information (BAR= 01, NOT VALID).

Step 16:

This test step verifies that the 1090 ES Ground Station is performing consistency check track behaviour (only Vertical Rate) because this function is switched on.

Scenario simulates an ADS-B aircraft and simulated inputs do match expected track behaviour (Vertical Rate is within the valid range based on “ADS-B Emitter Category SET”). Internal Vertical Rate BAR value is set to VALID and ASTERIX reports of the target do have information (BAR= 11, VALID ONLY FOR A TEST SUBSET).

Step 17:

This test step verifies that the 1090 ES Ground Station is performing consistency check track behaviour (only Vertical Rate) because this function is switched on.

Scenario simulates an ADS-B aircraft and simulated inputs do not match expected track behaviour (Vertical Rate is out of the valid range based on “ADS-B Emitter

Category SET"). Internal Vertical Rate BAR value is set to NOT VALID and ASTERIX reports of the target do have information (BAR= 01, NOT VALID).

Step 18:

This test step verifies that the 1090 ES Ground Station is performing consistency check track behaviour (only Vertical Rate Change) because this function is switched on.

Scenario simulates an ADS-B aircraft and simulated inputs do match expected track behaviour (Vertical Rate Change is within the valid range based on "ADS-B Emitter Category SET"). Internal Vertical Rate Change BAR value is set to VALID and ASTERIX reports of the target do have information (BAR= 11, VALID ONLY FOR A TEST SUBSET).

Step 19:

This test step verifies that the 1090 ES Ground Station is performing consistency check track behaviour (only Vertical Rate Change) because this function is switched on.

Scenario simulates an ADS-B aircraft and simulated inputs do not match expected track behaviour (Vertical Rate Change is out of the valid range based on "ADS-B Emitter Category SET"). Internal Vertical Rate Change BAR value is set to NOT VALID and ASTERIX reports of the target do have information (BAR= 01, NOT VALID).

Step 20:

This test step verifies that the 1090 ES Ground Station is performing consistency check track behaviour (all validations: Velocity, Acceleration, Acceleration Change, Heading, Heading Change, Altitude, Altitude Change, Vertical Rate, and Vertical Rate Change) because all these functions are switched on.

Scenario simulates an ADS-B aircraft and simulated inputs do match expected track behaviour ((all validations: Velocity, Acceleration, Acceleration Change, Heading, Heading Change, Altitude, Altitude Change, Vertical Rate, and Vertical Rate Change are is within the valid ranges based on "ADS-B Emitter Category SET"). Internal BAR values is set to VALID and ASTERIX reports of the target do have information (BAR= 00, VALID).

Step 21:

This test step verifies that the 1090 ES Ground Station is performing consistency check track behaviour (all validations: Velocity, Acceleration, Acceleration Change, Heading, Heading Change, Altitude, Altitude Change, Vertical Rate, and Vertical Rate Change) because all these functions are switched on.

Scenario simulates an ADS-B aircraft and simulated inputs do not match expected track behaviour (none of Velocity, Acceleration, Acceleration Change, Heading, Heading Change, Altitude, Altitude Change, Vertical Rate, and Vertical Rate Change). BAR values are set to NOT VALID and ASTERIX reports of the target do have information (BAR= 01, NOT VALID).

Step 22:

This test step verifies that the 1090 ES Ground Station is performing consistency check track behaviour (all validations: Velocity, Acceleration, Acceleration Change,

Heading, Heading Change, Altitude, Altitude Change, Vertical Rate, and Vertical Rate Change) because all these functions are switched on.

Scenario simulates an ADS-B aircraft and simulated inputs do not match some of expected track behaviour (Velocity, Acceleration, Acceleration Change are OK, and Heading, Heading Change, Altitude, Altitude Change, Vertical Rate, and Vertical Rate Change are NOT OK). BAR values are set to VALID and NOT VALID consequently, and ASTERIX reports of the target do have information (BAR= 01, NOT VALID).

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the GS system under test into the related test configuration.			
2	Prepare the test reporting capture tools to capture related GS system ASTERIX CAT-21 and, optional, GS system 'Raw Data Output' reports.			
3	Prepare the test message source to play the test scenario.			
4	Play the test scenario.			
5	When the test scenario is complete, stop the recording of ASTERIX CAT-21 and, optional, GS system 'Raw data output' reports.			
6	Analyze the recorded data:			
7	Input test scenario versus ASTERIX CAT-21 reports and			
8	Optional, Input test scenario versus GS system 'Raw data output reports			
9	Verify that the GS system under test has generated the expected outputs, and has fulfilled the test objective.			

Exercise result:

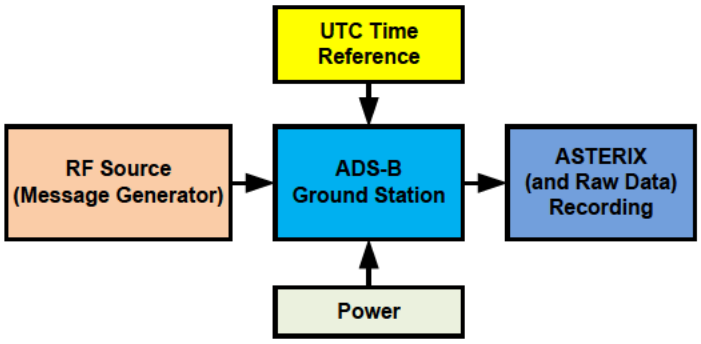
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 11: Verification Exercise Result

I.1.12 Verification SUT requirements

N/A

I.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

- Ground Station ADS–B
- Message Generator
- ASTERIX (and Raw Data) Recording Tool
- Power Source
- UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports (and optionally, Raw Data).

Message Generator

The Messages Generator will be capable to generate the data coming from the Remote System (ADS–B Ground Station or 1090 Receiver) like:

- **Target data stream** with inside the information extracted by the ADS–B message (ASTERIX CAT 21 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

- **Operational Data Stream** with inside the Remote System's Operational Status Information (ASTERIX CAT 23 in the case of Ground Station or Raw Data in the case that remote system is a 1090 MHz Receiver).

UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

I.1.14 Verification Platform needs

See section **3.5 Verification Platform Needs**.

I.1.15 Platform Configuration

N/A

I.1.16 Configuration(s) Identification of the Verification Platform

N/A

I.1.17 Links to other Verification Exercises

N/A

I.1.18 Representatively level/ limitations

N/A

I.2 Exercises Planning and management

I.2.1 Activities

N/A

I.2.1.1 Preparatory activities

Set up the tools/equipment listed in 3.5 and I.1.13 in order to meet the Test Preconditions.

I.2.1.2 Execution activities

Play the scenario generating in the input the desired messages and record the relevant ASTERIX (and Raw Data) output.

I.2.1.3 Post execution activities

The post execution activities will be mainly focused on the analysis of recorded ASTERIX reports (and Raw Data reports). The analysis shall be done in order to verify the right information propagation as requested in each Test Scenario.

I.2.2 Human Resources

N/A

I.2.3 Responsibilities in the exercise

N/A

I.2.4 Training

N/A

I.2.5 Time planning

N/A

I.2.6 Risks

N/A

I.2.7 Errors and Observation handling

N/A

I.3 Analysis Specification

I.3.1 Data collection methods

The data collection during the test will be Qualitative. In fact after the test execution the analysis of ASTERIX Data will be performed verifying that the values reported in the output are in line with the values generated in the input.

I.3.2 Analysis method

N/A

I.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 items.

Appendix J
Verification Exercise EXE-15.04.05.a-TS.0000.0030 – GS Automatic Bandwidth optimization techniques

J.1Exercise Scope and Justification

J.1.1 Exercise Level

The level of the exercise is performance.

J.1.2 Exercise Type

The type of this exercise is Test

J.1.3Description of the system being addressed

ADS–B Ground Station.

J.1.4 Context of the verification exercise

This document is applied to FAT (Factory Acceptance Test).

J.1.5 Required Datasets

1090 MHz Extended Squitter Messages input and 1090 GS ASTERIX output

J.1.6 Verification objectives

Verify that the 1090 ES Ground Station is able to realize an automatic network bandwidth optimization to get the optimal data send rate and data content to comply with the required system performance.

OBJ-15.04.05.a-TS.0000.0030
The ADS-B Ground Surveillance Domain has the capability to monitor the load of the network.

OBJ-15.04.05.a-TS.0000.0032
The aim of this objective is to check that the ADS-B Ground Surveillance Domain has the capability to detect the overload of the network.

OBJ-15.04.05.a-TS.0000.0034
The aim of this objective is to check that the ADS-B Ground Surveillance Domain has the capability to automatically reduce the load of the network in case of a detected overload, switching to the next level down of degraded data mode.

OBJ-15.04.05.a-TS.0000.0036
The ADS-B Ground Surveillance Domain has the capability to automatically switch back to the next level up of degraded mode or to the normal mode related to the load of the network in the case the detected network load has improved and passed a threshold over a configurable period of time.

OBJ-15.04.05.a-TS.0000.0038
The aim of this objective is to check that the ADS-B Ground Surveillance Domain has degraded data mode that could imply:

• omission of optional items (several subsets could be configured); • reduced data update rate; geographical filtering

OBJ-15.04.05.a-TS.0000.0040
The aim of this objective is to check that the ADS-B Ground Surveillance Domain has a configurable adaptation strategy (including parameters and switching decisions).

OBJ-15.04.05.a-TS.0000.0042
The aim of this objective is to check that the ADS-B Ground Surveillance Domain has means to indicate to external users the currently used mode level (normal, or level of degradation).

J.1.7 Inputs

A number of targets in order to simulate the maximum network load set in the GS configuration

J.1.8 Outputs

ASTERIX Report Recording.

J.1.9Entrance criteria

Start the generation 1090 MHz Extended Squitter messages in order to achieve maximum network load set in the GS configuration.

J.1.10 Exit Criteria

The Test will finish after all the steps will be done and once all outputs have been recorded and analyzed.

J.1.11 Exercise procedure

Exercise ID/Title: EXE-15.04.05.a-TS.0000.0030 / GS Automatic Bandwidth optimization techniques

Pass Criteria:	The test is passed if all the steps specified below are successful.
Exercise Type:	Test
Precondition(s):	The test equipment setup will be in line with that described in Section J.1.13 (see below). The test messages shall be configured in order to simulate targets, all within the coverage range of the 1090 ES Ground Station
Note(s):	Since this is a test of the basic system capacity, no FRUIT will be used in the test.
Device(s) in use:	Ground Station ADS–B Input Source for ADS –B Message. ASTERIX Recording Tool Power UTC time Reference

Exercise Procedure:

Step	Action	Expected Reaction	Pass/Fail	Comment
1	Put the 1090 GS in the default configuration.			
2	In the 1090 GS select Data driven reporting mode			
3	Configure the recording tool to capture ASTERIX reports coming from the ADS-B GS.			
4	Set the adaptation strategy for the first degraded data mode. Set the effects of the new strategy at output (omission of optional items, reduced data update rate or geographical filtering)			
5	Prepare the message source to play the scenario			
6	Enable the injection of the RF test signals.			
7	After the target injection is started, start the ASTERIX data recording. Note: this delay is required to acquire all targets.			
8	From the CMS Enable the use of Automatic Bandwidth optimization. Check from the SNMP client that the network load of the ADS-B is reported. Note the value “n” of the network load.			
9	After 2 minutes, set the Capacity Threshold parameter to n-5			
10	2 minutes later Set the Capacity Threshold parameter to n+5			
11	1 minute later stop the ASTERIX data recording			
12	Confirm that before execution of step 9, a normal data mode is			

	reported from ASTERIX Cat23.			
13	Confirm that within the 2 minutes period from execution of step 9 to execution of step 10, the level of degraded data mode has changed automatically and shows the currently used mode level in ASTERIX Cat23 record,			
14	Confirm in ASTERIX Cat23 that after execution of step 10, the degradation mode level is normal level again.			
15	From Asterix Cat21 record, confirm that within the 2 minutes period with degradation mode = 1, the effects of the adaptation strategy have been reflected.			

Exercise result:

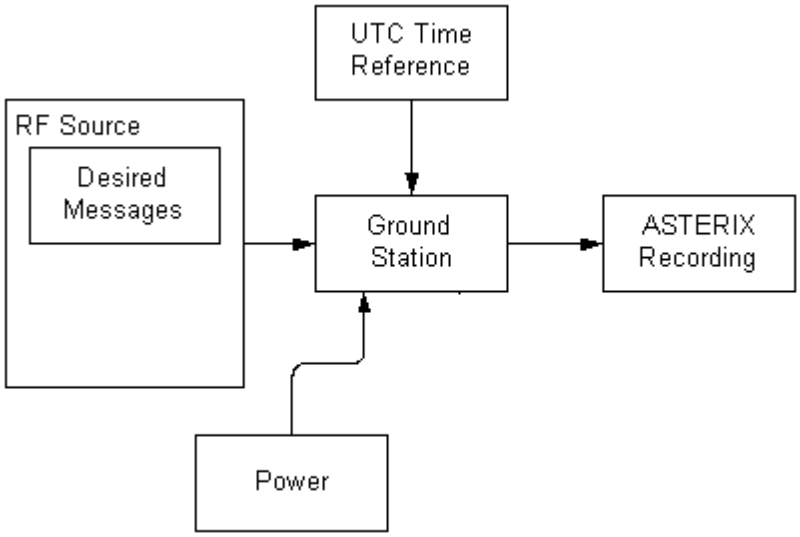
	Pass	Fail	Done By (Name, Organisation)	Configuration(s) during the exercise	Date

Table 12: Verification Exercise Result

J.1.12 Verification SUT requirements

N/A

J.1.13 Exercise Tool, Verification Technique and/or Platform



The Exercise will be verified in a platform with the following foreseen tools/equipment:

-Ground Station ADS–B

-RF Source for ADS –B Message

-ASTERIX Recording Tool

-Power

-UTC time Reference

The Item reported above will be capable to perform the functionalities reported below.

Ground Station ADS-B

The primary function of the 1090 GS is to receive 1090 MHz Mode S Extended Squitter messages, extract the data contained therein, and create appropriated ASTERIX Category 21 and 23 Reports.

RF Source of Desired Messages

The RF Source of Desired Messages will be capable to generate the Desired 1090 MHz messages in accordance with the Standard DO 260 – DO 260A – DO 260B.

UTC Time Reference

The UTC Time reference is the solution adopted in the Test Scenario in order to provide the Synchronization in the Ground Station by UTC Time.

ASTERIX Recording Equipment

The ASTERIX recording equipment will be capable to record all ASTERIX reports sent from the 1090 ES Ground Station.

J.1.14 Verification Platform needs

See section 3.5 Verification Platform Needs.

J.1.15 Platform Configuration

N/A

J.1.16 Configuration(s) Identification of the Verification Platform

N/A

J.1.17 Links to other Verification Exercises

N/A

J.1.18 Representatively level/ limitations

N/A

J.2 Exercises Planning and management

J.2.1 Activities

J.2.1.1 Preparatory activities

Setup the tools/equipment listed in 3.5 and J.1.13 in order to meet the Test Preconditions

J.2.1.2Execution activities

Play the scenario generating in the input the Desired 1090 MHz messages and record the relevant ASTERIX output.

J.2.1.3 Post execution activities

The post execution activities in order to verify the Bandwidth optimization consists in the verification from the recorded data that the information about degradation mode level of ASTERIX Category 023 changes automatically when the Capacity Threshold is exceeded and the effects in the ASTERIX Category 021 target reports are the expected (omission of optional items, reduced data update rate or geographical filtering).

J.2.2 Human Resources

N/A

J.2.3 Responsibilities in the exercise

N/A

J.2.4 Training

N/A

J.2.5 Time planning

N/A

J.2.6 Risks

N/A

J.2.7 Errors and Observation handling

N/A

J.3 Analysis Specification

J.3.1 Data collection methods

The data' s collection during the test will be Qualitative..

J.3.2 Analysis method

N/A

J.3.3 Data logging requirements

The data logging requirements for this scenario will foresee at least ASTERIX CAT 21 and ASTERIX CAT 23 item.

Appendix K
Preliminary Coverage Matrix[1]

Requirement ID	Requirement Title	Verification Objective ID	Verification Objective Title	Exercise ID	Exercise Title
REQ-15.04.05.a-D19-0012.0003	Surface squitter decoding	OBJ-15.04.05.a-TS.0012.0003	Surface squitter decoding	EXE-15.04.05.a-TS.0012.0003	ADS-B surveillance parameters in Manoeuvring area
REQ-15.04.05.a-D19-0012.0004	Surface squitter minimal information	OBJ-15.04.05.a-TS.0012.0004	Surface squitter minimal information		
REQ-15.04.05.a-D19-0022.0001	Position Report Update Interval	OBJ-15.04.05.a-TS.0022.0001	Position Report Update Interval	EXE-15.04.05.a-TS.0022.0001	GS Report Probability for Target on the airport surface Manoeuvring Area
REQ-15.04.05.a-D19-0022.0002	Emergency Mode Items Update Interval	OBJ-15.04.05.a-TS.0022.0002	Emergency Mode Items Update Interval	EXE-15.04.05.a-TS.0022.0002	GS Update probability on airport manoeuvring area for emergency mode items
REQ-15.04.05.a-D19-0022.0003	Non-changing ADS-B Items Update Interval	OBJ-15.04.05.a-TS.0022.0003	Non-changing ADS-B Items Update Interval	EXE-15.04.05.a-TS.0022.0003	GS Update interval for non-changing ADS-B items
REQ-15.04.05.a-D19-0022.0004	Identity Information Update Interval	OBJ-15.04.05.a-TS.0022.0004	Identity Information Update Interval	EXE-15.04.05.a-TS.0022.0004	GS Changing Identity Information on the airport surface Manoeuvring Area
REQ-15.04.05.a-D19-0022.0005	Integrity Failure Probability	OBJ-15.04.05.a-TS.0022.0005	Integrity Failure Probability	EXE-15.04.05.a-TS.0022.0005	GS Integrity and continuity failure in APT environment
REQ-15.04.05.a-D19-0022.0006	Continuity Failure Probability	OBJ-15.04.05.a-TS.0022.0006	Continuity Failure Probability		
REQ-15.04.05.a-D19-0030.0001	WAM Decoding	OBJ-15.04.05.a-TS.0030.0101	ADS-B/WAM Shared infrastructure opportunity	EXE-15.04.05.a-TS.0030.0001	GS WAM Integrity Check
REQ-15.04.05.a-D19-0030.0002	Duplicate Addresses Management	OBJ-15.04.05.a-TS.0030.0102	Duplicate Addresses Management		
REQ-15.04.05.a-D19-0030.0003	ADS-B/WAM Altitude Data Comparison	OBJ-15.04.05.a-TS.0030.0103	ADS-B/WAM Altitude Data Comparison		
REQ-15.04.05.a-D19-0030.0004	ADS-B/WAM Altitude Consistency Reporting	OBJ-15.04.05.a-TS.0030.0104	ADS-B/WAM Altitude Consistency Reporting		
REQ-15.04.05.a-D19-0030.0007	ADS-B/WAM Mode S Enhanced Data Comparison	OBJ-15.04.05.a-TS.0030.0107	ADS-B/WAM Mode S Enhanced Data Comparison		

[1] Coverage Matrix between D19 and D09 is provided in D09, Annex A

Requirement ID	Requirement Title	Verification Objective ID	Verification Objective Title	Exercise ID	Exercise Title
REQ-15.04.05.a-D19-0030.0008	ADS-B/WAM Mode S Enhanced Data Consistency Reporting	OBJ-15.04.05.a-TS.0030.0108	ADS-B/WAM Mode S Enhanced Data Consistency Reporting		
REQ-15.04.05.a-D19-0030.00011	ADS-B/WAM Velocity Data Comparison	OBJ-15.04.05.a-TS.0030.0111	ADS-B/WAM Velocity Data Comparison		
REQ-15.04.05.a-D19-0030.0012	ADS-B/WAM Velocity Data Consistency Reporting	OBJ-15.04.05.a-TS.0030.0112	ADS-B/WAM Velocity Data Consistency Reporting		
REQ-15.04.05.a-D19-0040.0040	TDOA Calculation	OBJ-15.04.05.a-TS.0040.0140	TDOA Calculation	EXE-15.04.05.a-TS.0040.0040	GS Time Differential of Arrival Validation
REQ-15.04.05.a-D19-0040.0042	TDOA Processing	OBJ-15.04.05.a-TS.0040.0142	TDOA Processing		
REQ-15.04.05.a-D19-0040.0044	TDOA Techniques reporting	OBJ-15.04.05.a-TS.0040.0144	TDOA Techniques reporting		
REQ-15.04.05.a-D19-0040.0080	TDOA Techniques Use	OBJ-15.04.05.a-TS.0040.0080	Track behaviour validation	EXE-15.04.05.a-TS.0040.0080	GS Track Behaviour Analysis
REQ-15.04.05.a-D19-0040.0082	Configurable acceptable data value ranges	OBJ-15.04.05.a-TS.0040.0082	Configurable acceptable data value ranges		
REQ-15.04.05.a-D19-0040.0084	Verification Process	OBJ-15.04.05.a-TS.0040.0084	Verification Process		
REQ-15.04.05.a-D19-0040.0086	Verification Process	OBJ-15.04.05.a-TS.0040.0086	Verification Process		
REQ-15.04.05.a-D19-0000.0030	Network load calculation	OBJ-15.04.05.a-TS.0000.0030	Network load calculation	EXE-15.04.05.a-TS.0000.0030	GS Automatic Bandwidth optimization techniques
REQ-15.04.05.a-D19-0000.0032	Network overload calculation	OBJ-15.04.05.a-TS.0000.0032	Network overload calculation		
REQ-15.04.05.a-D19-0000.0034	Automatic switch-over status to degraded mode	OBJ-15.04.05.a-TS.0000.0034	Automatic switch-over status to degraded mode		
REQ-15.04.05.a-D19-0000.0036	Automatic switch-over status to normal mode	OBJ-15.04.05.a-TS.0000.0036	Automatic switch-over status to normal mode		
REQ-15.04.05.a-D19-0000.0038	Degraded data mode actions	OBJ-15.04.05.a-TS.0000.0038	Degraded data mode actions		
REQ-15.04.05.a-D19-0000.0040	Configurable adaptation strategy	OBJ-15.04.05.a-TS.0000.0040	Configurable adaptation strategy		
REQ-15.04.05.a-D19-0000.0042	Bandwidth mode status signal	OBJ-15.04.05.a-TS.0000.0042	Bandwidth mode status signal		

Table 13: Coverage Matrix

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